Municipal Engineering; Paper No. 1.*

BOSTON, MASSACHUSETTS.

(*Continued from page 164.*)

STREETS.

Superintendent of Streets.

Snow Removal.—The removal of snow and ice from the Boston streets is done by contract under the direction of the Superintendent of Streets. The practice is about as follows:—After each heavy snow contractors offer to clear certain streets or blocks for a fixed sum based on the amounts; the Superintendent of Streets awards the contracts with little formality, and the men are at once sent to work, they furnishing their own labor and horses and carts. The snow is usually dumped into the nearest dock or on to waste land.

The street railway companies are practically forced to clear the whole streets, through which their lines run, of snow. If they plough snow from their tracks and throw it to the sides of the streets so as to obstruct travel there, the abuttors simply shovel it back on the tracks again; as a practical consequence the companies find it advisable to remove the snow from the whole street.

The employés of the Superintendent of the Board of Health removes the snow from the public parks and keep the crossings clear of slush.

The Board of Street Commissioners.

This board is made up of three members, who are "able and discreet citizens of Boston." Their term of office is three years, and under an Act of the Massachusetts Legislature of 1870, which defines their duties, etc., one member of the board is elected annually by popular vote.

The law gives them all the power in the matter of laying out, altering and discontinuing the streets or ways of the city, and the power, formerly exercised by the board of aldermen, of abating taxes relating to streets.

They can, in any one municipal year, order work done in laying out or altering any one street to the amount of $10,000; but for any proposed work exceeding this amount in estimated cost they must first submit such order for work to the City Councils, for their concurrence or rejection. If, however, the City Council takes no definite action within 30 days after such order is laid before them, and do not transmit a certified copy of their proceedings to the board, the order goes into effect at such time as the board may determine.

The Street Commissioners themselves do not expend the money, but simply order that certain work be done. The execution of the order depends upon the Superintendent of Streets and the amount of his appropriations.

Laying out Streets. In laying out new streets, if the Board of Street Commissioners and the property owners disagree as to location, the board can refuse to accept the street, when the latter if opened, comes under head of "private" streets.

If owners or abuttors offer a new street to the city for its acceptance, the city very generally requires the street be offered to it at an acceptable grade. If the city accepts the street, it pays for the surfacing and paving. In the case of an entirely new street the first brick pavement and curbing are assessed to one half of their actual cost upon the owners. If a sidewalk already exists, the city must at its own expense readjust this sidewalk and curb to any new grade.

Private Ways.—As already stated, Boston has over 200 miles of what are called "private ways." These belong in fee to the abuttors and over them the city exercises no authority: they are unaccepted and unrecognized. To warn the public and to absolve the city from any damage for accidents happening to persons travelling upon them, the city puts up signs at their entrance conspicuously announcing that "THIS IS A PRIVATE-WAY, DANGEROUS PASSING," or "PRIVATE WAY, PERSONS CAUTIONED NOT TO TRAVEL THEREON. These private ways must be paved, and maintained at the sole expense of the owners. We believe the Board of Health has certain powers over their condition, requiring them to be kept clean.

Widening Streets and Betterments.—When the board decides to widen any existing street, the owners effected are notified at once, and at the same time that the board intend to take the property and assess betterments. These betterments are a certain sum assessed upon each property, according to the judgment of the Street Commissioners, and are based upon an increase in value of property by reason of a wider street or the creation of new outlets to a street which was previously no thoroughfare. Before the owner knows the amount he is assessed as a betterment on the part to be taken, he can surrender the whole property and the city is bound to take it at a fair valuation. This property is then sold again by the city with the betterment assessed upon it. Boston has thus frequently acquired estates which have been sometimes sold at a profit.

One-half the full amount of the betterment assessed on any property is paid by the city, the other half by the owner. But the law expressly provides that the amount actually paid by the owners shall never *exceed* the entire estimated cost of the improvement intended in widening or opening a street. It is not intended that the city shall make any profit in the matter.

This assessment for betterment is a direct lien on the property improved, and the amount of money derived from this source, is applied to the general extinguishment of the city debt. If the property owner objects to the amount assessed, he can appeal within one year to the Supreme Court to have his estate and the improvement upon it reassessed by a jury.

Street Names and Numbers.—The names given to new streets are selected by the Street Commissioners. In the city proper, there is little if any system followed in this respect; in South Boston, however, streets running across the peninsula are lettered, and in some other parts of the city the first letters in the names of streets are arranged alphabetically. The later street signs are made of glass with the name showing in red; the letters being formed by the sand-blast process. These signs were attached to the city gas-lamps at the street corners, but the introduction of the electric light and the consequent abandonment of many gas-lamps has caused the signs effected to be valueless at night; and in many cases the signs have been entirely removed along with the old gas-lamps. No satisfactory solution of this problem seems yet to have been arrived at.

HEALTH DEPARTMENT.

The Board of Health.

This board is composed of three members, one of whom is appointed annually by the Mayor, subject to the confirmation of the board of aldermen, and such member holds office for three years, from the first Monday in May of the year of his appointment.

The duties of the board relate generally to the care of the public health, the establishment and maintenance of bath-houses and the quarantine of vessels. They may make such regulations for the promotion of the public health as they deem necessary, and as are not inconsistent with the city ordinances.

They are allowed the following subordinates: One city and one assistant city physician; one port and one assistant port physician; six clerks and fifteen inspectors. These officials all have specific duties to perform, which do not, however, come properly within the scope of these articles.

The Superintendent of Health.

Appointment and Duties.—This officer was formerly appointed by the Board of Health, but he is now appointed annually by the Mayor, subject to the usual conditions of confirmation.

The duties of this officer are very important in Boston, and his department is an interesting one. He must clean the public ways and catch-basins of the city, remove house-dirt, ashes and offal to the satisfaction and under the regulations of the Board of Health, and has the care and maintenance of the city teams and stables.

As subordinates he is allowed three clerks, sixteen foremen, and such assistants and laborers as may be necessary, and for whose compensation an appropriation shall be made. The Superintendent of Health, Superintendent of Streets, and one member of the Board of Fire Commissioners, constitute a board for the purchase of all horses and fodder needed for all the city departments using horses; the supplies thus purchased are paid for, however, from the appropriations of each department. This board meets twice a month or oftener for the transaction of business.

Before describing the methods of the department under the control of the Superintendent of Health, a word of introduction is, perhaps, necessary to enable our readers to better understand the reason for the prevailing discipline and the thoroughness of work performed by this official in Boston. The secret of success here lies in the fact that the executive head is, first, a very efficient man, and secondly, that this qualification has been appreciated by the appointing powers to such an extent that though nominally appointed each year, he has actually continued in office for about twenty years. The practical result of this wise, though unusual policy in the selection of city officers, is a well trained and efficient corps of assistants and an able experienced head to guide them. Permanency of employment has made positions in this department, even of the lowest grade, highly desirable, and having many to select from and being free to choose, the best of the applicants only are selected; the choice of the Superintendent being for young married men. This is city civil service of the best type; apparently brought about by an honest desire to benefit the city and the public rather than the political "worker."

The Removal of Ashes, Offal, Etc. In the removal of city refuse, the first requirement of the city ordinances is that no ashes or other material matter or house rubbish shall be mixed with the animal or vegetable waste, usually called "swill." This material must be placed by the householder in suitable, separate receptacles; the ashes usually in metallic tubs so that there may be no danger from fire, and the house-waste, or swill, in a tight vessel. These receptacles must be located in an "easily accessible place" on the premises, usually inside the yard; the city scavengers are required to remove them from the yard and return the empty vessels to their proper places.

The "swill" is removed daily from all hotels, markets, restaurants and other points of rapid accumulation; it is taken from dwelling-houses three times a week during the summer months, and twice a week in winter.

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For this purpose the city is divided into forty-nine districts to each of which is assigned one swill-wagon, a driver and a helper. With each wagon are two offal-buckets (Plate 28, Fig. 1,) in which the swill is transferred from the house receptacle to the wagon; Fig. 2, in the same plate, is an offal-chisel used in chopping frozen matter out of the house receptacle. This swill-wagon has a thoroughly water-tight body, containing about 64 cubic feet, and is closed by tight, hinged wooden covers; there is absolutely no dripping, nor any offensive odor. The collection is made during the whole day up to 5 P. M., and the daily average of each wagon is from two to three loads, depending on the length of haul to the depot.

When the wagon is filled it is taken to one of the three city depots, in Boston, Roxbury or Charlestown, and the contents are there dumped out upon a tight, raised platform, and the wagon itself thoroughly cleaned inside and out before being sent after another load. This "swill" is readily sold to farmers for feeding hogs and cattle, customers hauling it as far as twenty miles from Boston in tight, covered wagons, which are required on the

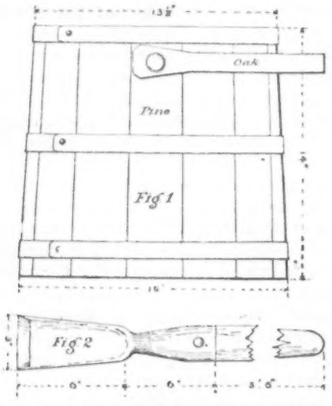


Plate 28.—Offal Bucket and Offal Chisel.

part of the farmers by the communities they pass through. The prices paid per cord (128 cubic feet) in 1885 were, in Boston, $4; in Roxbury, $5, and in Charlestown, $6.

In the official year of 1884-85, the department employed in this service 108 men and 49 one-horse swill wagons. This force collected 28,520 loads; or, averaging the loads at 60 cubic feet, about 63,400 cubic yards of house-offal or "swill." The cost of labor was $87,-691.93, and the amount realized from the sale of offal in the year was $36,420.52.

In collecting ashes and house-dirt, the city is again divided into seventy-six fixed routes: to each of which is assigned a one-horse cart, a driver and a helper. This class of refuse is removed from hotels, tenement houses and stores twice in each week, and from dwelling-houses once a week.

The ash-carts contain about 44 cubic feet, and must be covered with canvas when being hauled through the streets. The city employés enter the house, yard or shed of the citizen and remove the ashes to the cart, but they are not required to go up stairs. This plan practically does away with the nuisance of sidewalks blocked with unsightly or offensive vessel of refuse awaiting the city carts. While the driver is taking the loaded cart to the nearest city dumping ground, the helper remains on the route and transfers the ash-barrels to the street ready for the next load. Each cart makes from six to eight trips per day, depending on the length of haul.

At the present time the main city dump is on the South Boston Flats, where this refuse is utilized in filling low land, chiefly belonging to the State of Massachusetts. This dump is the rendezvous of a motly crowd of general scavengers who make a precarious living by rescuing from the rubbish the rags, bottles, old metal and any other marketable material found therein. There are other dumping grounds on the Back Bay and in the outlying districts; but as all these dumps will very soon cease to be available, the Board of Health, in 1884, proposed to carry this refuse to sea and there dispose of it. Experiments were made to this end with ordinary dump-scows, such as are used in connection with dredges; but owing to the buoyancy and clogging nature of the material it was found that it would not sink through the bottoms of the scows, and sometimes twenty prisoners from the Deer Island Institutions would be engaged fourteen hours in clearing one scow. The Board then tried a Barney dumping boat

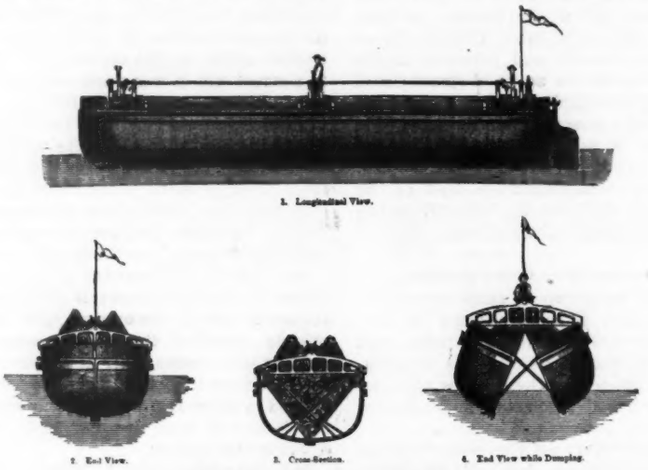


Plate 29.—Barney Dumping Scow.

(Plate 29) as used in New York harbor, and were so well pleased with its performances that in their last report (1885) they recommended the purchase of the boat at a cost of $12,000, and $1,500 annually as royalty. Previous to this recommendation they had hired the boat for $15 per day.

This Barney dumping boat is 110 feet long, 28 feet wide and 12 feet deep; its carrying capacity is about 500 tons, and when loaded it draws about 9 feet. It is thoroughly seaworthy in construction, and two men will dump the load, wash out and close the boat and be ready to return to port in from five to ten minutes. The illustration shows two strong hulls, or pontoons, secured together at both ends and in the middle by heavy bridges hinged to the pontoons. The storage room is V-shaped and the fastenings, at all three bridges, are operated from a center-wheel; the pontoons work automatically, and open and close as soon as released, the movement being about one-eighth of a circle. This Barney scow has been in use in Boston since June, 1884, and to April 1, 1885, it had dumped 14,823 "loads," making the trip once or twice a week as required. The Board estimated that the saving in horses, teams and labor exceeded $25,000 in the period named. As an additional source of income private parties were permitted to dump refuse material into the scow on the payment of ten cents per barrel.

During the year 1884-85, 162 men and seventy-two wagons were employed in the removal of ashes and house-dirt. This force collected 182,642 "loads" of ashes, and 62,222 of street-dirt; or, with an average of only 40 cubic feet per load, a total of 362,761 cubic yards. The cost of labor for this work was $125,902.21, and the amount received from the sale and removal of ashes was $14,159.76. On this basis the average cost of collection and removal was about 30 $\frac{8}{10}$ cents per cubic yard.

Plate 30, Fig. 1 shows a "snow drag" used by this department in removing ash-barrels from the yard to the street in winter. Fig. 2, is the source of unceasing tribulation and complaint on the part of the Boston housewife; it is a club used in loosening up frozen ashes in the barrels of the house holders, and besides being a formidable and effective instrument, is perhaps too frequently handled with unnecessary vigor.

Street Sweeping and Cleaning.—This work is done by the city with its own men, horses and machines. At the present time about 185 miles of streets are cleaned weekly, the work upon the business streets being usually finished before 7 A. M. During the winter months the teams are employed in moving house-dirt and some of the machines in cleaning crossings. In this latter service experience has shown that a one-horse sweeper will do more and better work than seven or eight men. Only paved streets are swept; on the macadamized and gravel streets in the districts, the gutters are kept clean and paper and other rubbish is gathered up. Sweeping such streets would naturally carry off the top dressing and lessen their durability.

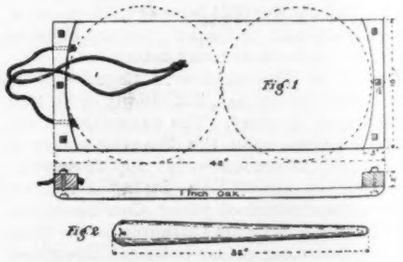
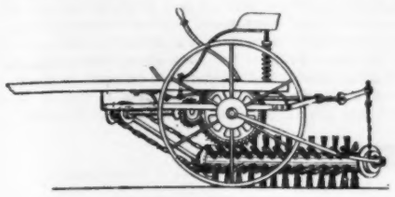


Plate 30.—Snow Drag; Ash-barrel Club.

The sweeping machines now used are built by the department under the patent of Aaron Stackpole, Jr., of October 23, 1883, (Plate 31). The original machine is intended for one horse only, but the department in some of the latest made, have fitted them for two horses by adding a pair of front wheels and a pole. This two-horse machine has decided advantages, and two horses can work in it all day, while in the smaller machine one horse can only work one-half day; the substitution of rattan for the usual "bass" in the broom, though more expensive, is found to be much more efficient, especially in handling slush in winter, and in sweeping gravel from the railway tracks.

The work of street sweeping as practiced in

Boston is worthy of a detailed description, both as an evidence of the discipline of the laborers, and as a contrast to the slovenly manner in which similar work is performed in some other cities. Taking a street of average width as an example, the first on the ground is a city watering cart which differs only from that used in ordinary street sprinkling in having finer jets, or openings in the sprinkler. After this cart come usually two one-horse sweeping machines, which travel *in echelon* so that vehicles may pass between them; these machines commencing in the middle of the street sweep the dirt towards the two gutters, making several turns over the block if the street is wide. Then come two men with broad hoes who gather the dirt into rough piles on each side of the street, the distance between piles being regulated by the quantity of matter swept up. Then we have generally four men armed with the ordinary birch brooms, two men to a gutter, who clean up the intervals between the piles and go into the angles and corners that the machine can not reach. And finally come the one-horse carts with two men to each; one man shovels in the dirt, and the others assist him in filling his shovel with the special carter's broom shown in (Plate 32).



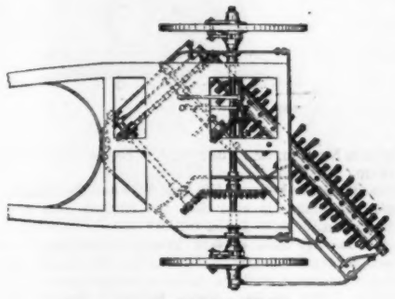


Plate 31.—Stackpole Sweeper.

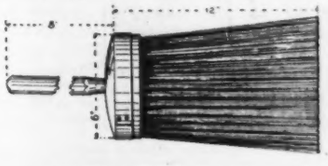


Plate 32.—Teamster's Broom.

In the year 1884–85, there were employed in this service, 181 men (eighty-seven being sweepers), thirty-four carts, ten sweeping machines and six watering carts. The principal streets were cleaned daily, the others twice a week: as previously stated, 185 miles of streets are cleaned each week. The quantity of street-dirt removed was about 92,180 cubic yards, and the cost for the year for labor was $97,280.10. This street-dirt is disposed of in the same manner as the ashes and house-dirt.

So that the cost of street cleaning under the Boston system may be better understood we have secured the following figures from Mr. M. B. Rowe who has a general supervision over the work under the Superintendent of Health:

The department "day's labor" is ten hours. The wages paid in 1885 were as follows: Teamsters, $2.10; teamsters' helper, $2.02; driver of sweeping machine, $2.10; sweepers, ash-cart and offal-cart drivers, and their helpers, $2.00 each.

The daily cost, without driver, of a watering-cart is figured at $2.00; one-horse sweeping-machine, $4.40 (allowance made for two horses, one in the morning and another in afternoon); two-horse sweeping-machine, $4.75 (here the same two horses work all day); one ash-cart and one offal-wagon, $2.10 per day each.

To get at some idea of the itemized cost of street cleaning we have taken, in summer-time, a street 66 feet between curbs, and a length of 8,385 feet. The total time occupied in cleaning this area of 553,410 square feet was 2¾ hours. The itemized cost we make as follows from data furnished by the Health Department:

No. Employed.	Class of Labor.	Cost per hour.	Total hours.	Total cost.
1	Watering-cart	$0.20	2.75	$0.55
1	Driver	.21	2.75	.57¾
3	Sweeping-machines	.44	8.25	3.63
3	Drivers	.21	8.25	1.73¼
6	Men with hoes	.20	16.50	3.30
12	" " brooms	.20	33.00	6.60
8	Carts	.21	22.00	4.62
8	Teamsters	.21	22.00	4.62
8	" helpers	.20¼	22.00	4.44½

Total cost of sweeping 553,410 sq. feet = $30.07½

At this rate, the cost per 1000 square feet would be $0.054; or on one mile of the same street 66 feet wide, it would be $18.81½.

TO BE CONTINUED.

Rail-Joints, Rails and Sleepers.

BY C. PETER SANDBERG, ASSOC. M. INST. C. E.

PART 1.—RAIL JOINTS.

Introduction.—The reason for this paper is to be found in the news recently received from America that fish-plates break frequently, and that steel rails wear badly. The most curious fact is that the angle fish-plates do not break through the bolt-holes, but right in the middle where the rails are joined, and not from the bottom but the upper edge. This seems to indicate that one of the joint sleepers must have sunk, so as to put the upper part of the fish in a state of tension instead of compression. As a remedy, some railway administrations have actually increased the length of the angle fish-plates to 44 inches so as to cover three sleepers, of which one is directly under the rail-joint: which means that they have both supported and suspended joints. For more than twenty years rails and rail-joints have been a specialty with the author in connection with the supervision and inspection of large rail contracts for America; as well as of observation of the wear of rails and rail-joints on the railways of Europe. The rails which have been found to wear badly in America are principally of American manufacture, and the fish-plates are also exclusively of American make. This paper will be confined to a statement of observations in Europe. This may lead to an explanation of the phenomena observed in America, while at the same time it may serve as a warning to European railway managers to avoid the errors committed elsewhere.

Old Rail-Joints.—Finding the plain fish-plates too weak, not so much through breakage as through the sinking of the joint and the flattening of the railends, the author, in 1865, began a great number of experiments in order to ascertain the comparative stiffness of rails and rail-joints. The results were published in the Journal of the Iron and Steel Institute, and in several engineering papers on this side of the Atlantic. The first suggestion, with a view of strengthening the rail-joint, was to do away with the pear-shaped railhead in order to obtain a reversible fish-plate of smaller fishing-angle, so as to obtain less work upon the bolts, in order that they might not work loose. In the first series of "Standard rail-sections," published in 1870, this angle was fixed at 22°. But as experience proved that there was some difficulty in rolling rails to this angle, it was increased to 30° in the second series of standard sections for steel rails, published in 1878. The old pear-shaped form had, however, double this angle, or 60°. Several million tons have been rolled to the author's standard sections, mostly of 50 pounds and 56 pounds weight per yard; and the largest proportion has been sent to America. The next thing was to abolish the notching of steel rails in the flanges, except in the corner of the rail-end, and to drill the bolt-holes instead of punching them. About this time the use of suspended instead of supported joints was introduced, in consequence of the flattening of the rail-ends. The author did not advocate this remedy, as is proved by a passage in the pamphlet just referred to, where it was said "It was a poor way to strengthen the weak point of the line (the rail-joint) by taking away the support under it." There was, however, no help at the time, and seeing that the suspended joint would be generally introduced, efforts were directed to securing, if possible, equal stiffness of the joint, as of the solid rail, through the use of stronger fish-plates.

Modern Rail-Joints.—It was soon found that the joint with plain fish-plates would not carry more than say, on an average, one-third of the load carried by the solid rail before taking permanent set, the distance of supports being the same as generally obtained. Different shapes of fish-plates were therefore examined, with the view of determining which would give most stiffness, and out of the great variety of shapes a selection of two distinct sorts, the angular and the deep form, was made. The angular shape projected only to the rail-base, but offered a much wider base, extending horizontally so that the slot, or holes for the spikes, would fix it to the joint sleepers, and thus prevent the creeping of the rail longitudinally. The deep fish projected vertically under the rail-base 2 or 3 inches, thus preventing the travel of the rail by the fish abutting against the sleepers. In both instances the rail-flanges could be left without any notches.

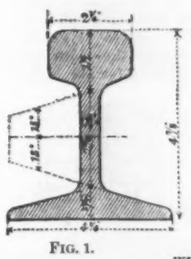


Fig. 1.

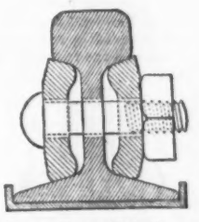


Fig. 2. Plain Fish-Joint with Elworth's Bridge-Plate.

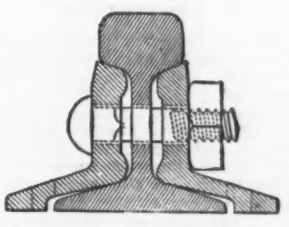


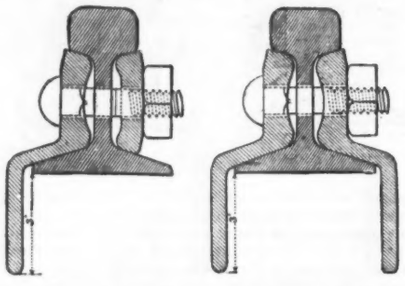
Fig. 3. Double Angle Fish-Joint.

In 1876 the author suggested that the Administration of the Swedish Government railways should undertake some comparative experiments with these two kinds of fish-plates, on a tolerably large scale on their lines, so as to ascertain which of the two forms would be the better to adopt. The plain joint then in use, both supported and suspended, had resulted in flattening of the rail-ends long before the rails were worn out, so that many thousand tons had to be taken up and reduced in length by cutting off one foot at each end, and fresh bolt-holes had to be drilled in order to relay the rails, and get their full wear out of them. This proposition was acted upon by the Administration, who not only ordered one thousand pairs of each of the two kinds of fish-plates, but in addition, got another joint designed by the chief engineer of the permanent way, Mr. Elworth. This consisted of an iron bridge-plate, with flanges on both upper sides bearing on the two joint sleepers, something like the Fisher joint in America, but in conjunction with ordinary plain fish-plates on the sides of the rails. As the sudden replacement of plain fish-plates by either angle or deep fishes on so extensive a system as the Swedish State railways would have been very expensive, it was proposed to carry out the exchange gradually, by applying at first only one new fish-plate on the outside. With this view different joints were tested, viz., one plain, with one angle, or one deep or one plain on either side, and the result is shown in the table kindly furnished by Mr. Elworth, which is all the more valuable inasmuch as the information has not hitherto been published. The author had frequent opportunities of examining the line with these experimental rail-joints, and can testify that each of them had perfectly fair play, there being no

† Read before the Institution of Civil Engineers by Mr. Christer Peter Sandberg, Assoc. M. Inst. C. E.

predisposition for or against any one of them, but only a single aim, namely, to arrive at the best and cheapest rail-joint. The table shows that the bridge-plate joint (Fig. 2) gave the least number of flattened rail-ends; next to that the angle fish, and lastly the deep fish-plates; it shows also that the plain, in conjunction with the deep and the angle fish, gave the worse results. Notwithstanding that the bridge-plate joint with ordinary fishes gave the best result, as having less flattened rail-ends and fewer sunken joints, it was considered too expensive for adoption. The deep fish, although giving the stiffest joint, a joint fully as stiff, indeed, as the rail itself, was somewhat disliked by the platelayers and trackmen, in consequence of the severe Swedish climate; snow and ice covering the line for say half the year.

The angle fish applied on both sides of the rail joint obtained much favor with the platelayers, but though it became the favorite, yet for economical reasons the exchange has been only gradually effected, one angle fish-plate being applied on the outside and one plain on the inside. This has been gradually accomplished so that the whole of the Swedish State railways, about 2,000 miles in length, are now laid with this rail-joint. In future, however, angle fish-plates are to be applied on both sides of the rail-joint as fast as the plain ones wear out, and the iron rails are changed for steel rails.



SINGLE DEEP FISH-JOINT. DOUBLE DEEP FISH-JOINT.

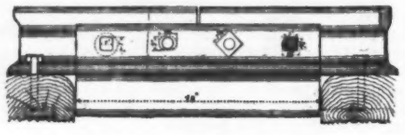


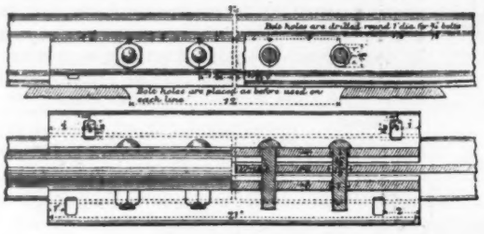
FIG. 4. DEEP FISH-JOINT.

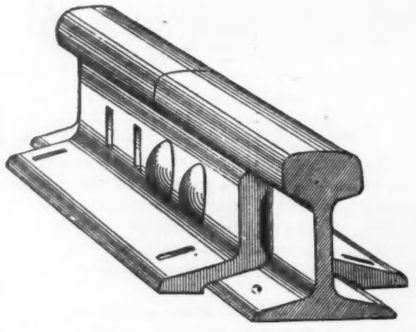
Many of the private lines in Sweden are also laid partly with one angle and one plain, and partly with two angle fish-plates, and up to the present time with satisfactory results.

In Denmark, in 1876, the author's suggestion was adopted on the Sjelland State Railway between Corsor and Copenhagen, and angle fish-plates provided on both sides the rail, and the whole line is now laid in this way. Thus in Denmark also the result of several years' experience has been satisfactory; there has been no breakage of fish-plates, no sunken joints, and no creep of the rails. In Germany angular fish-plates have long been in use, both for ordinary wooden sleepers and in connection with the iron or steel sleepers now generally used there, but they differ from the author's sections. The latter afford contact all along the upper part of the rail-flange (Figs. 5), while the German type (Figs. 3), only affords equal contact between rail-flange and fish as between rail-head and fish, so there is less probability of bolts keeping tight, although there is equal strain on the bolt on the upper and lower side. Judging of the comparative merits of these systems from the number of loose rail-joints in the respective countries, the author claims that the Scandinavian type of joint is decidedly the best. At the Antwerp Exhibition of 1885 the author's rail-joint for 50 pound rail was exhibited, and also the one for 63 pound rail, made for Denmark, with fishes 26 inches long, and they are favorably spoken of in the report of the Belgian State railways. The angle fishes have thus far shown no signs of failure in Europe, similar to those reported from America; but from their general adoption, say, during the last ten years, it is clear they have been regarded by engineers generally as an improvement on the old plain fish-plates. It is true they offer only two-thirds of the stiffness of the solid rail, and the joint sleepers have, therefore, to be lifted now and then; but the increased stiffness of two-thirds, as compared with one-third of the value formerly attained with plain fishes, is a decided improvement. Again, the large base which they offer at the joint sleepers, and the four spikes holding the rails to gauge, are features which cause them to be liked by engineers.

Some lines in Germany have adopted the deep fish-plate with even better results than the angle, so far as stiffness is concerned, for the line may have with the deep fishes the same stiffness at the joints as in the solid rail. In France flange-rails are used, but they are generally of heavier weight than in Germany, say, 70 to 80 pounds per yard. Generally plain fish-plates are employed, and joints are laid on the sleepers, but the ballast is good (often being stone), and this is a great help in keeping the joints from sinking.

In England double-headed or bull-headed rails (not intended to be turned) are mostly used with cast-iron chairs, and deep fish-plates for suspended joints, which suit better with this than with the flange section. The fish-plates are only 16 to 18 in. long, and weigh 30 to 40 pounds, yet no rail-joint keep better than these; hardly a sunken joint can be detected, and no better or quicker travelling than on the English railways is anywhere to be found. The rails are 80 pounds per yard or more, and in this great weight lies the secret, which will be referred to under the head of "Wear of Rails."





FIGS. 5.—SUSPENDED RAIL-JOINTS USED IN SWEDEN.

The Make of Fish-plates:—The make of the fish-plates, whether of steel or of iron, is left to the option of the manufacturer. Generally they are punched hot, straightened in a press, and the ends filed or cleaned by an emery-wheel from burrs left from the saw. Sometimes they are cut with shears. For inspection of the angle fish-plates the author has adopted a block of the same section as the rail, with four dubbs, or projecting pieces, placed as the fish-bolts in the joint. When the fish-plates are fitted into the block for ascertaining the accuracy of the section and bolt-holes, two clapps fixed to the block are turned up with two dubbs, which enter the holes or slots for the spikes to prove that the spike-holes are in their proper place in relation to the bolt-holes. This is a great improvement, and it only costs the time of an ordinary laborer to put on every fish-plate, and thus secure a perfect fit in the rail-joint.

Of course the square bolt-hole weakens the fish-plate more than the round one; nevertheless, in the absence of failure, the author has of late adopted square bolt-holes in both, and the spike-hole 1 inch from the one end and 2 inches from the other. By this mode both fish-plates are alike, so that makers require only one block for punching bolt and spike holes, and at the same time engineers do not require to keep their fish-plates in pairs as hitherto, only one kind being needed; still the spike-hole will come 2 inches out of the center line, so as not to split the sleeper. If the fish plates are made of steel and punched cold, they must be annealed afterwards in order to regain the strength lost in punching. The drawing (Figs. 5) of a complete joint for a light line is of the most modern type, and the same kind is used for heavy lines, but then it is somewhat larger, say, 24 to 17 inches in length. Such is the mode of making and using the angle fish-plates in Europe, and nowhere has the author ever heard complaints of their breaking. Figs. 6 and 7 (for which the author is indebted to the courtesy of Mr. John Fritz, of the Bethlehem Steelworks, Pa.) show the form of angle fish-plates on some of the best lines in America. From these figures it may be seen that they are a great deal stronger than those introduced in Sweden, or, at any rate, there is more meta in them.

The difference between the American and the Swedish angle fish-plates is also that the former have slots while the latter have holes for the spikes. But this is no reason why they should break by thousands on American roads, as stated in the *Railroad Gazette*, 1885 where numerous articles have appeared under the heading, "Why do Fish-plates Break?" During the last six months many explanations of this most unfortunate phenomenon have been published in the *Railroad Gazette*, but these have been not altogether satisfactory. Indeed, fish-plates are said not to be the right thing for obtaining a perfect line, and bridge-plates, or the so-called "Fisher" rail-joints, are strongly advocated. In the year 1873, when rails broke through the bolt-holes at the time of punching, and the rails were made much harder than they now are, the author looked upon the Fisher joint (Figs. 8) as hopeful; but, after drilling the bolt-holes had put an end to this kind of fracture, the Fisher joint seemed to remain unnoticed, until recently revived in America. Indeed, during the author's long experience he has only had to inspect one order for rails for the Fisher joint; this was about 15,000 tons for Savannah in 1882. It need not be said that the rail-ends for this joint must be quite square, the section most correct, and the corner notches for the bolt through the rail-flange very exact.

Rail-joints Generally.—To obtain a line of equal strength and stiffness throughout is no easy task, in consequence of the expansion and contraction produced by the difference between summer and winter temperature.

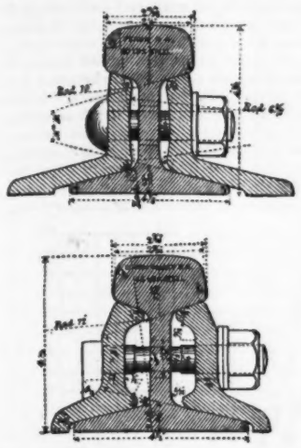
To have a joint that can open, say, ¼ inch, and shut completely as the temperature changes, and yet be of equal stiffness with the solid rail, is certainly not a simple matter. Even if these conditions were fulfilled the flattening of the extreme ends of the rail-head is almost unavoidable, at least for a weak rail of soft metal. To prove this, a cut, say, ⅛ inch deep, and ¼ inch to ⅜ inch wide, was made in the head, in the middle of some steel rails, and they were laid down on the Swedish State line. It was found after a few year

RESULTS OF EXPERIMENTS WITH DIFFERENT FISH-PLATES ON THE SWEDISH STATE LINES.

Year when the Rails had to be taken up for Flattened Ends. Iron Rails 63 pounds per Yard.	Elworth's Bridge-plate or Channel-iron, with plain Fishes.	Angle Fish-plates.			Deep Fish-plates.		
		On both Sides of the Rail-joint.	On the Inside, with a Plain Fish on the Outside of the Rail-joint.	On the Outside, with a Plain Fish on the Inside of the Rail-joint.	On both Sides of the Rail-joints.	On the inside, and a Plain Fish on the Outside of the Rail-joint.	On the Outside and a Plain Fish on the Inside of the Rail-joint.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent	Per Cent.	Per Cent.
1879.....	0.8	1.6	3.2	2.4	1.6	1.6	3.2
1880.....	2.0	4.8	7.2	11.2	11.2	16.0	11.2
1881.....	3.6	8.0	9.6	16.0	4.8	4.8	8.0
Total of the five years' wear. Flattened rails at the ends in per cent. of laid rails	6.4	14.4	20.0	29.6	17.6	22.4	22.4

(The above seven different kinds of rail joints were laid in 1876.)

wear, that there were edges flattened on the rail-head just at the joints; hence it is the want of support of the molecule just at the end of the rail-head which causes the metal to flow or spread (a kind of "flow of solids," as ably described by Tresca), and this all the more as the rail-steel is soft. In order to avoid flattened rail-ends, the corners are sometimes filed off, but there is wanted a hard metal and a big rail-head, of which the end is not crushed or squeezed out of form. Anyhow, with steel rails it is not so bad as with iron rails, where



FIGS. 6.—RAIL-JOINTS USED IN AMERICA.

the imperfect welding caused the ends to be crushed and spread out as a broom. The angle fish-plates having been extensively introduced into Sweden and Denmark, and several other countries, the news of their breaking largely on American railways will naturally cause much anxiety on this side of the Atlantic; and should the same sad experience show itself in

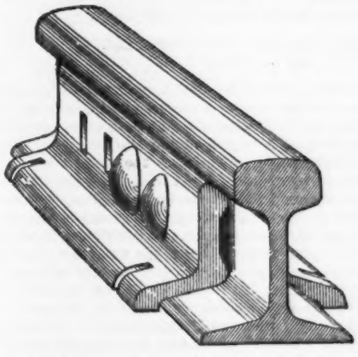


FIG. 7.—RAIL-JOINTS WITH SLOTS FOR SPIKES USED IN AMERICA.

course of time here, the author would be the first to look to the Fisher joint or to any other plan to obtain greater safety. He has no particular interest in any joint; yet, so far as experience goes, the angular fish-plate has been found much better than the plain fish-plate. In countries with a severe climate, the deep fish-plate was found to be objectionable; but it has the advantage in mild climates, and particularly in England, for double-headed or bull-headed rail-sections.

PART II.—THE WEAR OF RAILS.

The second item in the news from America is that steel rails wear badly, so that some are worn out in a very short time. In the spring of 1885 the *Railroad Gazette* contained an article on the wear of steel rails, in which it was stated that the result of wear on some American lines had been rather indifferent, and that a commission had been sent to Europe to enquire whether there was any reason for believing that English rails were superior to those made in America. Their conclusion, in short, was that good and bad rails could be made, and were made, in Europe as well as in America; and that it rested with the railway companies to protect their own interests. The following are the errors they indicated:

If certain companies bought the cheapest possible rails without choosing a good maker, or if they applied no specification, inspection or supervision of the manufacture, or did not test the rails, either for wearing qualities or for safety, they naturally must have taken for granted that all steel rails were equally good or bad, and they had to buy their experience. If, above all, they overloaded their rails with too heavy rolling stocks, or used a 50-lb. rail, of perhaps an indifferent section, where they really should have used a 60-lb. or 70-lb. rail, they made the mistake of trusting too much to the small abrasion of steel as compared with iron, particularly as it had to be made very soft so as not to break. But any railway company that took proper care of its interest in choosing a good maker, and having a good specification with careful honest inspection, and a sufficiently heavy section, could have rails which gave good results whether they were made in America or in Europe. On the whole, the experience in Europe of the wear of steel rails is good; but then the errors noted are generally avoided. However, one of the leading railroad presidents in the United States followed the best of all tests, "experience." He had had excellent experience of the rail he had obtained about eighteen years ago through a certain firm in England, and he did not hesitate to order 10,000 tons of similar rails through the same channel, although it will cost $100,000 more than if the rails were made in America.

Chemical Composition of Rail Steel.—Through these results of the wear of rails in America the question of the chemical composition of rail steel comes again to the front. To show that pure steel may not always give satisfactory results in wear, the author had a few steel rails made of the purest raw materials, for trial on an English railway with heavy traffic, and the result was that they barely came up to the ordinary English steel rail in wear, because they were too soft. They contained about 0.3 per cent. of carbon and hardly any other hardeners. Of course the rail steel can be made harder without any risk of breaking, if the material is almost free from phosphorus and silicon. The experience cited above is, however, a proof that even with the purest steel the soft rail does not come up to the hard rail in resistance to wear. This is contrary to what Dr. Dudley, the chemist of the Pennsylvania Railroad, and others have advocated. Even in Sweden, which possesses magnificent deposits of pure iron ores, well adapted to the purpose of steel-making, the manufacture of steel rails has not been largely developed. This is due to the circumstance that Sweden does not possess coal suitable for iron manufacture; the only fuel used for this purpose is charcoal, and this would make rails so dear that a protective duty of 30 per cent. would be required to make it pay. This duty the State will not grant, but prefers to have cheaper railways, and plenty of them, laid with imported rails. There are now more than 4,000 miles open, which is a higher proportion taken per head of the population than in any other country in the world. It may be added that the Swedish railways have, on the whole, yielded financial results which are satisfactory; and from a technical point of view, the author can affirm that no country with a severe climate can show equally good results, whether as to wear or to absence of breakages. A steel with 0.3 per cent. of carbon, where phosphorus and silicon are low, would surely give a rail too soft for wear, and the carbon may then well be increased to 0.5. But if the phosphorus reaches 0.1 then it is not safe to exceed 0.3 of carbon, particularly in cold countries. As to the silicon, so small a proportion as 0.04 per cent., as Dr. Dudley prescribes, is in the author's opinion a source of blisters and unsound ingots as well as of many wasters in rolling. With 0.1 per cent. of silicon, the steel is more quiet and solid in casting, and the rails are equally strong for the falling test, and certainly better for wear. As rail steel in one district may vary very much in chemical composition from that in another, and still good rails may be made in both, it would be unpractical to stipulate in the speculation for only one definite composition. Nor is it wise to specify the amount of carbon only, because this should depend upon the amount of the other hardeners present. All that can be said is that rail-steel with carbon as the principal hardener and with a minimum of phosphorus is preferable, particularly in cold countries, and that the inspecting engineer should compare mechanical tests with the chemical composition of the rail, and try to find what hardness can safely be used in each individual case. There is no doubt that a rail of medium hardness wears better than that of soft or mild steel, however useful the latter may be for ship-plates and for constructive purposes.

Tests for Steel Rails.—Why a steel rail should be required to bear a heavier falling test than an iron rail is a question that makers were in the habit of asking engineers when steel-rail making was begun. The reply was, because of the irregularity of the rail-steel, which was sometimes hard and sometimes soft, as proved by the frequent breaking of steel-rails in the road. This was at the commencement of steel-rail manufacture, some fifteen years ago, and so the "barbarous" test of a ton falling 30 feet was introduced. The effect of this was the production of soft rail steel which would stand such a barbarous test, but the rails thus made now begin to show less durability in wear than the harder rails which were first made and subjected to lighter tests. During the last ten years, however, makers have greatly increased the probabilities of uniform production. The author observed this in 1881 both in England and in Germany, when inspecting 100,000 tons of steel blooms for rails to be rolled in America, and a definite chemical composition had to be adhered to. In fact, regularity of production is now generally obtained except with some new makers, who naturally cannot have the same experience as that acquired by old and long established firms. It is astonishing to note the regularity of production of Bessemer steel, and the only hardener which varies according to the heat of the blow is silicon. Bessemer steel is now made for tinplate works and for ship plates with an exceedingly small limit of carbon. The time has, therefore, come when railway engineers may depend upon regularity in the production of rails, and it is almost proved by practice on a large scale that the best wearing rail is one of medium hardness with say 0.5 per cent. of carbon, provided that phosphorus and silicon are at a minimum. Engineers would do well to reduce the so-called "barbarous" falling-tests to such as would enable makers to produce a somewhat harder rail than is now made, but still complying with perfect safety from breakage. The factors causing breakage are high speed, overloading of too heavy rolling-stock, bad roads and cold climate, and an over-schemed rail-section. With any of these elements of danger in excess it will be necessary to retain high falling tests, but then a soft rail must be accepted, from which a maximum of wear must not be expected. This is, however, no reason why the bulk of rails subjected to use on ordinary good railways under normal conditions should not now be made a little harder, so as to give better wearing results, since more regularity of production can be depended upon. The suggestion is, therefore, made that the falling tests should be regulated according to the weight of the rail, as shown in the table appended to this paper, always bearing in mind that the rule is applicable only under ordinary circumstances. The dead-weight tests should remain severe, but no maximum of deflection should be stipulated, beyond that of each rail carrying on a certain weight without permanent deflection. Of course, the section has a great deal to do with the results. The higher the rail-section the stiffer it is for the dead-

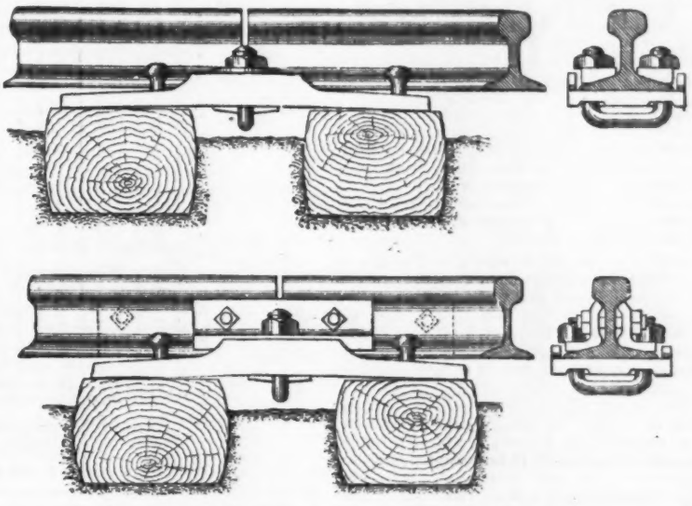


FIG. 8.—FISHER RAIL-JOINT AND IMPROVED FISHER RAIL-JOINT.

weight test, but the sooner it will break under the falling tests.

Over-schemed Rail sections.—Some engineers have of late increased the depth of rails, while keeping the same weight, guided by the theoretical formula that the stiffness is in proportion to the square of the height. This would be correct enough if the rail were a girder subjected to permanent dead weight only; but as the rail is subjected to blows or concussions as well as to abrasion, there is a practical limit to the saving of material in this way. Take, for instance, an over-schemed rail-section, say with half the substance in the head, one-quarter in a thin web of great height, and one-quarter of the substance in a wide and thin flange. With the modern quick-running rail-mills such a section can well be rolled, but the widely different proportions of the section will cause the flange to come out at a much lower heat than the head as compared with the author's standard section, in which there is an equal division of material, viz., one-third in the head, one-third in the web, and one-third in the flange. Not only is the latter easier to roll, but it leaves the rolls at a more even heat in the different parts. The former rail-section will have a strain which will always remain in it through the irregular cooling of the flange and the head; and this all the more as the steel is hard. With an ill-proportioned division of the material, the rails will in cooling draw very crooked, and require a great deal of rough mechanical treatment in cold-straightening under presses, which is often a source of fracture. The author's inspection-books generally show rejection of no less than 7 per cent. of crooked rails. Thus, the form of the modern overschemed section will in itself be an element of danger, through having a strain in it which will tend to cause breakage with a comparatively light blow when beset by a heavy engine at high speed, a sunken sleeper, or a cold climate.

As an instance of this undue saving of material, a case may be cited of a railway which, when constructed twenty-five years ago, was laid with 63-lb. iron rails; the weight of the engine was then 27 tons, and the speed comparatively low. Since then the engine has gradually been increased to 37 tons, while the speed is 50 per cent. higher, and the weight of the carriages more than doubled. Nevertheless, 63-lb. rails are still used, but of steel, and of a much deeper section than the original iron rail. In order to guard against breakage of rails in such a case the use of a heavy falling tests and of a soft steel is necessitated, but the wearing qualities of the rails must naturally be sacrificed. The introduction of modern rolling-mills has certainly enabled railway engineers to design more economical rail-sections than in former days, but to go on increasing the weight while keeping the weight the same, in order to meet the demand of increased traffic and produce a stiffer rail, can only result in a source of danger. The designer of a new rail-section should first of all think whether it can be easily rolled; but it often happens that he has never seen a rail rolled; hence the great number of bad sections in the market.

Wearing Results of Modern Steel Rails.—A communication to this Institution "On the Manufacture and Wear of Rails," in 1868, led to an animated discussion, and to the conclusion that steel rails, as far as experience had then gone, would last nine times as long as iron rails. It is doubtful whether the experience now at command would bear out this comparison, and for two reasons. First, the steel rails have been made softer than they were then; and, secondly, there is a great deal more work put on them without any increase in the weight of the rail. If steel rails as now made will endure three times as much wear as iron rails, this is as much as, generally speaking, can be expected from them. One high authority even calculates steel rails to be but slightly more durable than iron rails. The only country whose railways have been modified in accordance with altered circumstances is England.

The Weight of Steel Rails for Renewals on Roads with Heavy Traffic.—In effecting the change from iron rails to steel, the English engineers increased the weight of rails, say, twenty per cent., because they foresaw the heavier work on the road in future, and they got their rails cheaper year by year till the cost of steel was below that of iron rails (see diagram (fig. 9) of rail-prices per ton f. o. b. shipping port from 1855 to the present time). Continental engineers, on the contrary, reduced the weight of the steel rail twenty per cent. in order to compensate for the higher price of steel at the commencement, and since then they have increased the depth of section instead of the weight of the rail. The result is that while in England the principal lines are now completely laid with rails of at least eighty pounds weight per yard, and have chairs which offer a base of at least twelve inches in width, the Continental lines have mostly kept to their sixty pounds flange-rails, with a base of, say, 4 inches, and no chairs. How, then, could the results be expected to be the same on the Continent as in England? Allowing, say, one-quarter of the weight of the flange-rail for the flange, instead of chairs as used in England, the railway administrations on the Continent shall require a rail of 100 pounds per yard to correspond to the English eighty pounds, and still the width of base would not be more than half that of the chair. The Metropolitan rail-section weighs ninety-two pounds per yard, besides the chairs, but it is so rare to hear of a heavy flange-rail section that only a short time ago the heaviest flange-rail section in America, of eighty-two pounds per yard, was published in the *Railroad Gazette* as a monster. In instituting a comparison between the cost of English railways and that of a line laid with flange-rails, there must be added, in the former case, the value of the chairs; the value of the rails, sleepers, fish-plates, and bolts being the same in both cases. Taking the weight of each chair at forty pounds, and the cost of the chair at half that of the steel-rails, per ton, and one chair being used per yard of rail, it follows that the cost of twenty pounds of steel per yard must be added to the cost of the English rail, thus making its value equal to that of a flange-rail of 100 pounds per yard. Again, comparing the work done on the English railways with that on some of the lines on the Continent and in America laid with flange-rails, it will be found that the average speed is certainly higher in England; but then it must be remembered that there are often steeper gradients on the lines laid with flange-rails, and thus in many localities the speed, though less uniform, becomes quite equal to that in England. The engines on the Continental lines are often heavier than those in England, and the work to which the rails are subjected is therefore often quite as heavy as in this country. Have, then, the English engineers been using unnecessarily heavy rails, or have the Continental engineers been laying down rails that are too light? There can be no doubt as to which of the two have been in error, whether regarded from the point of view of safety or of economy. Since the introduction of steel-rails in England, derailment has diminished enormously, and the cost of repairs to the permanent way and rolling-stock much decreased; while the comfort in traveling is greater than in any other country. As the value of time becomes more appreciated by Continental travelers, and as the arrangements for international through traffic, with heavy rolling-stock, such as sleeping and dining-cars, become more general, the period must soon arrive when the 60-lb. rail will prove too weak, at least on the main lines, and the necessity of replacing it by a stronger rail than will then become urgent. This exchange of rails will perhaps take ten years before it can be completely carried out. Meanwhile the traffic will go on continually increasing, and also the speed; for statistics show that on some lines the weight of trains has actually been doubled in ten years. If, then, in making the change from the present 60-lb. rail, a 70 or 80-lb. rail is chosen, this will be found, by the time the substitution is completed, to be, like the former rail, much too weak. It will, therefore, in many localities be wisest to take the full step at once, and boldly adopt a rail of ninety or even 100 pounds section. Of the million tons of the author's standard sections which have been rolled, most up to the present time have been of fifty and fifty-six pounds per yard, and but few of sixty pounds. The sections of seventy and even eighty pounds, though published with the others as far back as 1870, have never been adopted. If designed on the same basis, the ninety pounds section would be 5¾ inches in height and in width of base; while the 100 pounds section should be six inches, with an equally strong head and web as that of the English bull-headed rail. These heavy rails should be joined, in countries where the climate is mild, with deep angle fish-plates, and the joints would then be of the same stiffness as the rail in the middle; but in countries with a severe climate they should be joined with angular fish plates, though the joints would then have only two-thirds of the stiffness of the rails, but the width of base would be increased by, say, three inches, making with the fish-plates nine inches at the joints. In suggesting this radical mode of improvement of flange rail-sections, the author is quite prepared to meet with great opposition from permanent-way engineers; but if they take the safety of the traveling public into consideration (and they will be the first to be blamed when accidents occur), and again if they take the saving maintenance of road, and particularly in rolling-stock, into account, to say nothing of the comfort in traveling, they may gradually come round to these views, and make a change for the better, in order to meet the demands of the future before it is too late.

Metal Sleepers.—It is a great mistake to diminish the rail section in consequence of the adoption of metal sleepers, as has been done on some railways; for the metal in the sleeper can in no sense make up for the metal in the rail. The strong rail has the power of spreading the effect of the concussions from the rolling-stock over several neighboring sleepers, thus dividing the effect; while the light weak rail will concentrate the blows on one or two sleepers. Again, the narrow rail-flange will soon wear off the surface of contact on the skin of both rail-flange and sleepers; and then fractures will soon occur, as the metal is not in layers like the iron made from a pile, but forms one homogeneous mass, in which the least crack may lead to a snap right through. The heavy flange-rail is therefore *sine qua non* for the success of a metallic permanent way, if by "permanency" be meant anything approaching thirty years or more. In 1880 the United States paid through their regulation of duties, as much for old worn-out rails as was then paid in England for new steel rails. But, even if this should not happen again the old material will always be equal in value to half the cost of new rails; this, of course, is another reason for not being niggardly in the use of metal when laying down new rails. It is to be hoped that the iron or steel sleeper now beginning to be introduced, and which may roughly be said to cost as much per ton, and weigh as much per mile of line, as the rails themselves, will enable the Continental roads to rise to the same standing as the English, and also that the adoption of steel sleepers in England (for their introduction is almost a certainty) will prove economical as well as safe. But if weight is to be saved with sleepers, as it has been with the flange-rails on the Continent, it is rather doubtful what will be the result; and, indeed, the few years of experience with metal sleepers on the Continent has shown that they have been made too light. It is a fact beyond doubt that steel rails and sleepers rust much faster than those made of iron. Why this should be is not quite clear. It may be due to the fact that iron rails and sleepers are rolled at a higher heat than steel, and with floating slag round the pile as a silicate of iron, which is not readily affected by water and atmospheric air; while the steel ingot is rolled at a lower temperature, free from slag, and its pure metallic surface is exposed to the action of air and moisture when put in stack before being laid on the line.

Weight of Rails for New Railways.—In speaking of the weight of rails from the point of view of safety and economy, a distinction should be made between rails for renewals on railways with increasing traffic, high speed, and heavy weight of rolling-stock, and those for railways under construction. In the former case where statistics may indicate that the traffic will be increased, or even doubled, in ten or twenty years, it is very false economy not to increase the weight of the rail-section. It is wise to begin at once, knowing that it may take a long time before the exchange is fully effected, and as a certainty the public will not conceed

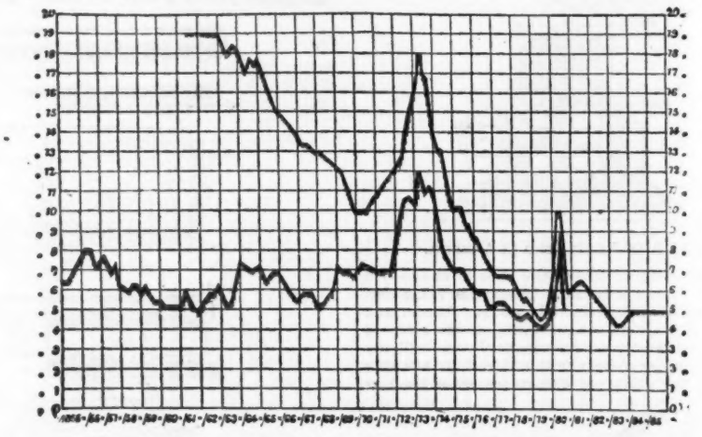


FIG. 9.—DIAGRAM OF AVERAGE PRICE OF IRON AND STEEL RAILS SINCE 1855.
The upper line represents steel, and the lower line iron.

PROPOSED TEST FOR STEEL RAILS.

LEVER TEST.					BALL TEST.					
Weight per Yard.	Distance of Bearings.	Load.	Deflection for Pieces, 6 Feet Long Rails.		Weight per Yard.	Distance of Bearings.	Weight of Ball.	Height of Fall.	Propor'n. of Test to Weight per Yard.*	Deflection for Pieces, 6 Feet Long Rails.
			Temp.	Perm.						
Pounds.	Feet.	Tons.	Inches.	Inches.	Pounds.	Feet.	Cwt.	Feet.		Inches.
30	3	5 11	⅛ ⅜ to ⅜	0 ⅛ to ⅛	30	3	10	6	2.0	2 to 4
35	3	6 13	⅛ ¼ to ⅜	0 ⅛ to ⅛	35	3	10	8	2.3	2 4
40	3	8 18	⅛ ⅜ to 1	0 ⅛ to ¾	40	3	10	10	2.5	2 4
45	3	10 22	⅛ ½ to 1	0 ¼ to ¾	45	3	10	12	2.6	2¼ 4¼
50	3	12 25	⅛ ⅝ to 1¼	0 ¾ to 1	50	3	20	8	3.2	2¼ 4¼
56	3	14 26	⅛ ¾ to 2	0 ⅛ to 1⅜	56	3	20	10	3.5	2¼ 4¼
60	3	16 32	⅛ ⅞ to 1¾	0 ¾ to 1⅜	60	3	20	13	4.3	2¼ 4¼
65	3	18 35	⅛ ⅞ to 1⅜	0 ¾ to 1¼	65	3	20	15	4.6	2¼ 4¼
70	3	20 41	⅛ 1 to 1¼	0 ¾ to 1¼	70	3	20	20	5.7	2¼ 4¼
75	3	22 43	⅛ 1 to 1⅜	0 ¾ to 1¼	75	3	20	23	6.0	2¼ 4¼
80	3	23 45	⅛ 1 to 1¼	0 ¾ to 1¼	80	3	20	25	6.2	2¼ 4¼
85	3	24 48	⅛ 1 to 1¼	0 ¾ to 1¼	85	3	20	26	6.3	2¼ 4¼
90	3	26 50	⅛ 1 to 1¼	0 ¾ to 1¼	90	3	20	29	6.4	2¼ 4¼
95	3	28 51	⅛ 1 to 1¼	0 ¾ to 1¼	95	3	20	31	6.5	2¼ 4¼
100	3	30 52	⅛ 1 to 1¼	0 ¾ to 1¼	100	3	20	33	6.6	2¼ 4¼

*The figures in this column are obtained by multiplying the weight of the balls in cwts. by the height of the all in feet, and dividing by the weight of the rail per yard in pounds. The lighter the rails the lower the speed and therefore the lighter the test in proportion.

anything, but will require more comfort and greater speed year by year, which will all tell upon the rail. But for permanent way in course of first construction the case is different. There two kinds of road should be recognized, according to local circumstances. First there is the case of flat countries, with small gradients and curves, where an even speed and light traffic is to be expected. For such a case light rails are sufficient, even for standard-gauge lines. For instance, in the south of Sweden there are many such lines now constructed for normal gauge, with 30 to 35 pound rails, at a cost of considerably less than 2,000 pounds per mile, rolling-stock included, and still this can carry the State-line trucks, and answers all local requirements; but, of course, the speed is low, the maximum being, perhaps, fifteen miles an hour. But a second case arises in hilly countries, for there it would be very false economy to use such a light rail, where the gradients are steep, say 1 in 60. A heavy rail is, indeed, the salvation of cost of construction of the line, as labor is dear and steel cheap. In this connection Mr. Mais, M. Inst. C. E., Chief Engineer of the South Australian Railways, says:—"In England it is everywhere conceded, by those conversant with the construction and working of railways, that to lay down light permanent way in hilly districts, where steep gradients must of necessity be used, is the reverse of economy, because to work steep grades heavy engines must be used, and therefore a light permanent way would be inadmissible; but on level country a light road may be adopted where the traffic is limited, and where there are no steep gradients." In America the temptation to economize the weight of rails must however, be immensely greater than it is in Europe, inasmuch as the price of rails is much higher; through 100 per cent. of import duty the rails were made for years doubly as dear as on this side of the Atlantic, but it is now greatly reduced. It therefore seems fair to suggest that the bad results in the wear of steel rails in America, now complained of, may be caused by the use of rails which are too light in proportion to the rolling-stock, the speed, and the traffic. It is true that the weight of the American engines and carriages is distributed on more axles than in Europe, and that the bogie is also apt to save the road to some extent; but with a demand for increased speed the total load of the engines and carriages must tell on the rails, and, therefore, the duration of a comparatively light rail must naturally be less than that of the heavier rail used in Europe, and particularly in England.

Reduced Tests for Steel Rails.—But as regards badly-wearing steel rails, the author knows of no better suggestion than to use harder steel (which would necessitate reduction of falling tests), and at the same time to use heavier rails. To increase the hardness, while keeping to the same weight of rail, may in many instances prove disastrous, and lead to fracture and accidents. The rail-makers' complaint, that it is the engineers' fault through stipulating too heavy tests, and forcing them to make a soft rail, might be true enough, but engineers were quite right to be on the safe side as long as irregularity in production existed. Now, as the time has come when engineers can obtain what they require, it is to be hoped that the change from soft to hard rail, in order to obtain better wearing results, will be effected gradually, and only after very mature considerations of safety before economy. The factors on the one side are weight of engine, rolling-stock, and speed, local circumstances, and climate; all these belong to the rolling-stock department. On the other side, to meet these demands on the permanent way, the engineer has to consider perfect safety obtained by providing a good road, a good rail, good rail-section of sufficient substance and weight, medium hardness of rail-steel, and a perfect rail-joint. Unfortunately, however, these two departments do not always pull together, very much to the loss of the shareholders, as well as to the risk of the travelling public. In executing the changes now suggested, the author's greatest wish is that perfect union may exist in the two departments, and that the temptation to economise by using a harder rail may not be effected at the sacrifice of safety; in most instances this can only be obtained by a proportionate increase in section and weight of the rail itself. With this view the above table for testing steel rails is submitted, in the hope that it will be for the benefit of the producer as well as the consumer:—

"Ceramite" as Paving Material.

Translated for ENGINEERING NEWS from an article by M. A. Gouvy, in the *Mémoirs de la Société des Ingénieurs' Civils*, October, 1885.

Among the exhibits at the Hungarian National Exhibition at Budapest, were pavements of "ceramite"* as manufactured by the "Societe des houilleres et briqueteries" at Rakos, near Budapest. The manufacture of these blocks commenced in 1875. In 1878, the process was crowned with success and the product showed a resistance against crushing exceeding almost any other artificial stone block.

The tests made by Prof. Horvath at Budapest show a resistance against crushing ranging from about 1,900 to 3000 kilos per square centimetre (27,000 to 42,660 lbs. per square inch) thus far exceeding the crushing strength of granite blocks. Dr. Böhne, of the Academy of Berlin, also made a series of tests with the following results:—Minimum resistance, 31,156 pounds per square inch; maximum resistance, 52,671 pounds.

At the time these experiments were being made (1879) the city of Budapest was seeking some material better than granite for its city pavements, and made a trial of the "ceramite" on one of its streets. This pavement was made in two distinct beds; 1st a lower bed or layer which was simply a complete walling in of the natural soil by means of ordinary, hard-burned bricks laid on the flat; and 2nd an upper or wearing surface of ceramite blocks, 4 by 8-inches by 4-inches thick.

In laying this pavement, the natural soil was first dressed to conform to the profile of the street and carefully rammed; upon this were placed the hard-burned bricks on their flat, having dimensions of 11½ by 4-inches by 3½-inches thick. Between the joints in this brick bed was poured a grout of cement mortar, and on top was placed a bed of sand $\frac{5}{16}$-inch deep. The under brick were placed with their long axis parallel with the street breaking joint with each other; the ceramite blocks were put on the sand diagonally to the axis of the street and laid dry. Into the joints of this upper surface was then poured a mixture made of one part hot coal tar, four parts ordinary pitch and fifteen to twenty parts of sand, according to the size of the sand grains. In place of the brick foundation, concrete can be used as with an asphalt pavement, when this base must be allowed to set before the ceramite is laid. In the case mentioned bricks were used because the manufacturers made both kinds and could save 20 kreuters per square metre over beton or concrete. The width of joints in this pavement is generally $\frac{1}{10}$-inch, varying with the size of sand used.

This pavement since 1881, has been used quite extensively in Budapest, some 20,000 square metres being thus covered.

The shape given to the block has been selected with a view of making it as light as possible and yet to have sufficient resistance in case they should be slightly out of the perpendicular. The weight of the size of block mentioned is about 22 pounds, and their cost 240 florins per thousand ($115.80); the cost per square metre of paving is $2.60½, or 5.⅛ florins.

The cost of laying the ceramite pavement, including the cost of ordinary brick base, and the labor, is in Budapest from $4.27 to $4.61, according to the size of the blocks used, per square metre.

In regard to cost of the ceramic paving it is, perhaps, interesting to note that it compares with other pavements in Budapest as follows:

Ceramite pavement (as above)	$4.27 to $4.61
Granite (Mauthausen quarries)	5.19
Impregnated wood (Rüttger system)	4.60
Asphalt *comprimé*	4.04
Asphalt *double coulé*	3.45

The contractor's guarantee for five years is included in the above prices; the figure demanded by, and granted to the contractor for the above guarantee is the same for all except wood, viz.: ten cents per square metre per year; for wood it has been fixed at twelve cents.

In comparing the various systems of street paving in use in Budapest, it is found that the circulation of vehicles on the asphalt paved streets has much diminished, the drivers preferring the parallel streets because of the smooth surface of the asphalt, which is laid on an 8-inch bed of béton. About one and a half miles of the boulevard Andrassy was laid in 1884 with pine wood blocks impregnated on the Rüttger system. At the time of laying this pavement presents as fair a surface as the asphalt, and the wood has the advantage of offering a better foot-hold to horses. But the wooden blocks are already commencing to break off at the corners and the bumping of vehicles passing over these unequalities is apparent. The ceramite gives a smooth surface, analogous to that of asphalt and wood, but it is harder. The diagonal lay of the blocks, while avoiding the slipping and affording a better foot-hold for horses, is the cause of a certain amount of noise but much less than with granite. The objections to granite are already well known; its rough surface caused by the tendency of the blocks to wear spherical on top, the noise and the wear on vehicles are all recognized evils.

From a hygienic point of view the ceramite is practically next to asphalt as a street paving material, and the dust arising from it is a minimum. The experiments at Budapest show that while the ceramite costs more than asphalt to lay, it costs less to maintain it in good condition, slipping is completely avoided and the wear is almost nothing.

*The article nowhere describes the method of manufacture or the constituent components of this "ceramite:" but judging from the context it is a specially made and burned brick paving block.

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ANNOUNCEMENT.

We will be obliged if subscribers who have not received the lithographed plates of the 1st and 2nd prize designs of Messrs. Hildenbrand and Schneider respectively for the Harlem river bridge, published February 20th and 27th in this journal, will notify us *at once*. By reason of an exceedingly stupid blunder of the lithographer in delivering the first plates at the wrong place, the Hildenbrand plate was not inserted in any of the copies sent out to New York and vicinity, and to the American News Co. In New York they were delivered by messenger immediately on discovery of the oversight, and they were included in the other papers of the following week. Application must be made without delay, if parties wish to secure the plate.

To Our Subscribers.

The presswork, folding, addressing and mailing of ENGINEERING NEWS, like most other weekly papers of this city, is contracted to outside parties, and *this office* has no knowledge of any mistakes or failures on the part of the contractors until complaints from subscribers are received through the mail. We pay them for well defined service, and we will be obliged if subscribers will at once make complaint in writing when everything is not up to standard—or "grade."

THE Executive Board of the Temporary Civil Engineers' Committee on National Public Works has issued a call for a convention of the Committee, to be held in Cleveland, O., on March 31st. The purpose of the convention is to close up the work of the temporary organization with the view of forming a permanenent organization on April 1st. The meeting will probably last three days and all engineers interested in the subject will be welcomed.

The Northern Pacific R. R. Company, having completed their surveys, are offering at a large discount a great variety of Civil Engineers' and Surveyors' Instruments. The list fills an eight page octavo pamphlet, which gives description of each instrument, its maker, price, and conditions of sale. They are of the best American make; the amount of repairs are specified and the instruments are sent out on approval. The advertisement is to be seen on another page.

IN response to queries concerning "The Main Drainage Works of Boston," by Eliot C. Clarke, C. E., referred to frequently in our paper on the municipal engineering of that city, we would answer as follows: By order of the city government of Boston, 200 copies of the second edition of this book are on sale for $1.25 each, with 15 cents additional for postage if delivered by mail. Address request to "City Messenger, City Hall, Boston, Mass." About 140 copies of this last edition are still on hand. It is an exceedingly valuable work, and we would advise all interested in the subject to write for it at once; the price is merely nominal, barely covering the cost of production.

WE take a warm personal pleasure in congratulating Mr. Rudolph Hering, of Philadelphia, upon his appointment as Chief Engineer of the Drainage and Water Supply Commission of the city of Chicago.

The position is one of great importance and responsibility, and the professional problems involved are calculated to test to the utmost the engineering judgement, experience and skill of him who treats them successfully.

Mr. Hering is still comparatively a young man, but he has fairly won his present enviable position by a professional life devoted to the close and deep study of similar questions, and by earnest, unceasing work. His previous experience and the results he has already accomplished have secured for him a well established reputation as an expert in sanitary engineering, both at home and abroad.

The salary attached to the present appointment, $10,000 per annum, is a maximum attained by but few engineers. But we mention it both to show what honest, persistent effort to win a professional reputation will do, and also as an encouraging sign that the services of a civil engineer are commencing to be appreciated at something approaching their true value.

From what we personally know of Mr. Hering, we are assured that the authorities of Chicago have occasion to congratulate themselves upon the wisdom of their selection.

The resolution of the City Council of Chicago, under which Mr. Hering is appointed, defines the duties of the position as follows:

The Mayor is to appoint a commission to consist of one engineer "whose reputation is so high that his opinion and report will command the respect of the community" and one or two consulting engineers of like experience in engineering and sanitary matters. This commission is to consider all plans relating to drainage and water supply which may be brought to its attention, make such examinations, investigations and surveys as are deemed necessary; collect all information bearing on the problem; to consider all develments of sewage disposal and their application to the present and future needs of Chicago; to consider and meet necessity of increasing the water supply and of protecting the same from contamination, to remedy our present inadequate methods of drainage and sewage disposal; to consider the relations of any system proposed to adjacent districts, and whether there may not be a union between the city and its suburbs to solve the great problem, to determine the questions as to the interest which the State and the United States may have in the disposal of sewage by way of the Illinois river, and to devise plans to meet any objections thereto, if such a system shall be thought best; and in general, to consider and report upon any and all things which relate to the matter of water supply and drainage of the city of Chicago.

The commission should report on the whole matter committed to it in the most full and comprehensive manner with maps, plans and diagrams complete, and accompany the report with estimates of the first cost and annual requirements for the maintenance of the system proposed.

The report of the commission should be made as early as practicable, and not later than the convening of the next session of the Illinois Legislature in January, 1887.

The chief engineer is to receive a salary of $10,000, per annum, and the fees of all the engineers engaged are not to exceed the sum of $20,000, nor all the expenses connected with the investigation and report, $30,000.

THE Johns Hopkins and Harvard Universities and Columbia College have announced their purpose to publish, at regular intervals a series of papers on political and economic science, especially as these relate to the government of our larger cities. They invite contributions from all quarters and impose no conditions upon the authors save that the papers shall possess sufficient merit to warrant publication.

The field for improvement in the management of our municipal affairs is wide; and if these publications are conceived in a free, broad common sense spirit, so as to awaken the "good citizen" and not tickle the close student of political economy alone, much good can be accomplished. Their authors should remember always that they want to stir up the solid element in our great cities and develop an interest in the science of government among a class that, as a rule, carefully avoid all political responsibility.

The trouble with our cities and the fundamental cause of the extravagence and dishonesty every day appearing, is that we have permitted a class to grow up among us who make a trade of politics, and have allowed this class to rule absolutely. The present conditions are all against honest government in the interest of the people, and all in favor of the individuals who devote their lives to filling a place regardless of personal fitness; and filling their pockets against the day when a more powerful "boss" will turn them out to make room for *his* henchmen.

Time was when the merchant and professional man took an interest in the management of the cities whose bills he had to pay; but they have no time in these busy days to devote to what would be to the honest man a comparatively unlucrative business, and they leave it to the professionals and grumble in the background at their tax-bills, and the little return for the money expended.

If the publications promised can awaken the honest majority to take the reins of government into their own hands and manage their own affairs, they cannot be issued too soon, nor too broadly distributed. But their authors must deal with these masses and not fire over their heads with abstruse theories, in an attempt to reach the student or professor of political economy only.

The Water Supply of London.

A great deal of dissatisfaction has for a long time been felt with the Thames as a water-supply in London, and three chemists of note, Professors Tidy and Odling with Mr. Crookes, have reported on its state each month for some years. When we remember that during the first two visits of the cholera to Glasgow the people were drinking the Clyde water, and the deaths were, in 1832, 2,800, and in 1854, 39,000; while, after the introduction of Loch Katrine water, only 68 deaths were reported in 1866 there seems some ground for nervousness. But it is probable that a great deal of the offensiveness of London water is due to lack of care bestowed on the cisterns, rendered necessary by the intermittent supply, as not only is their proper cleaning neglected, but in some instances their overflow pipes is the vent pipe from the house sewers.

The chemists report 127 examinations of the water during last January, and say that the general result of the examinations, extending now over the five years, shows its uniformly excellent state of æration and its habitual and increasing degree of freedom from turbidity, color and excess of organic matter.

The organic carbon in the water was found to be only 0.183 parts in 100,000, which is ascribed to the greater perfection of the filtering arrangements now in use.

The chemists are not yet ready to adopt the present methods of estimating the *bacteria* and other germs by cultivation, as they maintain that the practice, as it at present exists, is too crude to admit of exact results being attained through its agency, and they have determined to wait some months before determining how far the place of germ culture can be safely applied to water analysis.

PERSONAL.

A. H. WRIGHT has been chosen Superintendent and Inspector of the Rockland, Mass., Water Board.

L. L. GERRY, Superintendent of North Attleboro Water-Works, has resigned his position to take effect April 15, 1886.

HELEN M. OCKERSON, wife of JOHN A. OCKERSON, Assistant Engineer, United States Engineer Corps, St. Louis, Mo., died on the 7th at St. Louis. The interment was at Minneapolis, Minn.

A. W. HAWLEY, until last year Superintendent of motive power for the New York, New Haven & Hartford Railroad Company died in New York, March 12th. On December 28, 1848, he was the engineer-in-charge of the engine that hauled the first passenger train that ever ran from New York to New Haven. He began railroading as a fireman in 1844.

RICHARD W. SHERMAN, formerly of the firm of Sherman & McDonough, contractors, has been appointed City Engineer of Utica, N. Y. The Utica *Observer*, the official paper of the city, remarks editorially: "Mayor Kinney has been so fortunate as to secure an engineer for the office of City Surveyor and Engineer whose appointment will command universal approval His appointee is RICHARD W. SHERMAN, the eldest son of Gen. RICHARD U. SHERMAN, of New Hartford. He is an engineer of high repute, who has been enirusted with important work since he entered his profession a man of the firmest integrity and soundest judgment."

COL. CHAS. F. M. GARNETT died at Norfolk, Va., on March 6, aged seventy-six years. Col. Garnett began the profession of civil engineering on the Chesapeake & Ohio canal in 1829 under the late Charles Ellett He afterward served as assistant engineer on the Richmond & Petersburg R. R., and the Richmond, Fredricksburg & Potomac R. R., under Moncure Robinson. In 1835 he was Chief Engineer of the Greenville & Roanoke R. R., and late of the Raleigh & Gaston R. R. In 1842 he was appointed Chief Engineer of the State of Georgia and was engaged in the construction of the railroad between Atlanta and Chattanooga, and located the site of the former city. During his service in Georgia he was lamed for life by a railroad accident, He was then Chief Engineer of the Columbia & Charlotte, the Nashville & Chattanooga the Memphis & Charleston, the Richmond & York River, and the Virginia & Tennessee railroads. In 1856, by invitation of the emperor he was for three years the Chief Engineer of the Dom Pedro II. railroad in Brazil and returned to the United States in 1859. During the late war he was a railroad commissioner, chiefly occupied in transferring rails and material from abandoned roads to points where they would be of service.

MR. FRANKLIN DUANE, of the Auburn engineer corps of the P. S. V. R. R., while walking with another member of the corps, on the P. & R. R. R., at a point about 1,500 feet below the "Canal cut" and opposite Crossing No. 3, on the P. S. V. R. R., March 15th, stepped aside to let the express train from Pottsville pass, and as the last car passed he was struck on the forehead by a lump of coal, about 3 inches square, which felled him to the ground, and inflicted an ugly, though not serious, wound. The coal must have been caught by the whirl of the rapidly running train and striking a wheel, deflected with the result stated.

Engineers' Club of Philadelphia.

At the Regular Meeting of March 6th, President Washington Jones in the chair, the following papers were read:—

Wm. H. Dechant described, through the secretary, "A Practical Test to Operate a Distant Signal by a Wire run through a Pipe filled with Oil." The distance operated was 1,100 feet, partly along a four and six degree curve; a ¾-inch galvanized iron-pipe was fastened on stakes driven 8 feet apart and set in a trench 15 inches deep on a uniform grade. A $\frac{3}{16}$-inch signal wire, after it had been straightened, was pulled through this pipe by a No. 15 wire, B. G.; brass stuffing boxes were fixed at the ends, and the pipe then filled with common car lubricating oil, mixed with one-quarter part of refined coal-oil. The experiment proved very successful, with the advantages of being permanent; free from disturbance by accident; no trouble from expansion if pipe is laid below frost line, and very little at one foot below surface. The cost for materials was $5.38 per 100 feet for the pipe plan, as against $5.42 for the ordinary wooden box.

J. Foster Crowell exhibited and described a Rolling Lock Gate, designed by R. E. Peary, C. E., U. S. N., for the Nicaragua Ship Canal.

Prof. L. M. Haupt continued his paper on "Harbor Studies," as applied to the harbor of refuge at the Delaware Breakwater.

A number of mechanical devices were exhibited and described by members present.

Liverpool Engineering Society.

The usual fortnightly meeting of this society was held at the Royal Institution, Colquitt-street, Liverpool, February 24; Mr. Coard S. Pain, Assoc. Inst. C. E., president, in the chair. A paper on "Brick and Masonry Arches" was read by Mr. A. Wharton Metcalfe.

The object of the author in bringing the paper before the society was to give and contrast the empirical and theoretical modes employed in the design of arches, and also by presenting certain tables derived from the general equation to the equilibrium curve to illustrate the great advantage of the latter mode. By means of these tables the construction of the true curve of an arch, when designing a bridge, becomes an easy matter. The author also considered briefly the mechanical and graphical means for drawing the linear arch, and gave tables derived from actual examples prepared in the office, and calculated from the general equation to the linear arch. In dealing with such practical questions as the relative merits of brickwork and masonry in arches, and the systems of constructing the same, such as the ring and bonded methods, some valuable information was given, derived from the practice and experience of Mr. Charles Richardson, the engineer to the Severn Tunnel. The recent developements of long submarine tunnels have lent additional importance to the question of the relative merits of bonded brickwork and of brickwork built in rings; this, and its bearing upon the curves of arches subjected to water pressure from without, was discussed.

In conclusion, the importance of the subject was strongly urged, and more especially so as the recent movement in favor of ironwork in the place of brickwork and masonry was considered to be hardly reasonable when the quality, hardness, and durability of bricks now made has been taken into consideration, as well as the economy resulting from their use.

Michigan, Brick, Tile and Drainage Association.

This association commenced its annual meeting at Flint, Mich., March 9th, with forty manufacturers of brick and tile from this and others states present. The following officers were elected:

President, A. J. Ward, of Flint; *Vice-President*, Prof. R. C. Carpenter, of Lansing; *Secretary*, W. S. Confort, of Tecumseh; *Treasurer*, W. R. Quantrell, of Potterville.

A paper on "The sanitary necessity of main sewers in cities, running parallel with streams and emptying at a safe distance, instead of discharging direct into such streams," was submitted by Dr. Bela Coggeshall, of Flint.

At the evening session, Mayor Davison read an address of welcome, Gen. Humphrey, of Adrian, read a paper on "The Utilization of Heat," and Dr. J. C. Wilson one on "The Benefits Derived from Thorough Underdrainage for Farm Stocks." On the 10th, a paper on "Farm Drainage," was read by Hon. John T. Rich, of Lapeer. Lansing was chosen as the next place of meeting. The executive committee was instructed to adopt measures for securing a better attendance at the annual meetings hereafter.

A committee, consisting of Wm. Humphrey, Adrian; R. C. Carpenter, Lansing, and C. H. Harris, was appointed to confer with the State Board of Agriculture with a view of securing an amalgamation of the two bodies.

CORRESPONDENCE.

Problem.

EDITOR ENGINEERING NEWS:

LEBANON, PA., March 15, 1886.

In answer to the query of "Subscriber" regarding the radius of a circle cutting one acre from a field of ten and a half acres, the center of the required circle being on the circumference of the given circle, I would state that the radius of the required circle is equal to 10,627 perches.

GEO. W. HAYES, C. E.

Graphic Determination of Stresses on Rivets in Plate Girders.

WOONSOCKET, R. I., March, 12, 1886.

EDITOR ENGINEERING NEWS:

Your correspondents in Nos. 7 and 10, current volume, in regard to stresses on rivets in plate girders do not, it seems to me, cover the whole ground.

The vertical shear in the web cannot bring vertical stress on the rivet, because, for one reason, the flange has no capacity to carry it; hence for girders with load brought on the web by brackets or cross floor beams, Mr. Scheizer's method is right I think. In case however the load is directly on the top flange, like a railroad deck-girder, must we not take the imposed vertical load (a wheel pressure for instance) and combine it with the horizontal stress? This vertical stress will be constant the whole length of the girder.

Yours truly,

J. P. SNOW.

American Water-Works Association.

OFFICE OF SECRETARY,
HANNIBAL, MO., March 6, 1886.

Dear Sir:

Having failed to secure the required number of subscriptions, to justify the reprint of our five years' proceedings, as provided by the resolution authorizing the same, the matter is postponed until after the Annual meeting at Denver. Yours truly,

J. H. DECKER, *Secretary*.

The Ancient Reputation of Panama.

EDITOR ENGINEERING NEWS:

In a book now before me entitled "The Tehuantepec Railroad, its Location, Features and Advantages under the La Sere grant of 1869," published by D. Appleton & Co., the introduction which was written by Mr. S. Stevens, has a foot note which reads as follows: "Don Alonzo Guzman in the account of his voyage from the Island of Espanola to Peru via Panama in 1534, published by the Hakluyt Society in 1862, says, that on his arrival at the port of Nombre de Dios, in the province of Castilla del Oro (the present site of Colon) he learned that the native name of the place was *Bones*, and was so called on account of the number of persons who had died there." Though the present deadly character of the climate is well known to your readers, they may not know how well established that character is. Yours truly, N.

The Panama Canal.

ST. LOUIS, MO., March, 8th, 1886.

EDITOR ENGINEERING NEWS:

When shall we know the truth in regard to the Panama Canal? This is a question which it seems impossible to decide from the present outlook. So long as the Canal Company persists in publishing a bulletin which is only intended for the promotion of its interests in France, the general public is going to get very little information in regard to the true scope of the work, or anything which is in the least satisfactory to the engineering profession. It is difficult to understand why a full and clear exposition of all affairs would not be an advantage to all concerned. If they have a legitimate work requiring years to accomplish with an expenditure of many million of dollars, why keep the results of their efforts obscured? It will all be understood in the end, and if there are any honors they will fall where they belong, but what object is gained in the meantime by keeping the world uninformed? As an offset to the *Bulletin* there has just been published, in a French paper, a statement that real facts are suppressed, and that the death rate on the Isthmus is much greater than the company will acknowledge: It says of 30 French employès who landed at Aspinwall from the steamer Washington on Oct. 20th ult., one-half have since died—and that the mortality among the laborers is over 14,000 yearly. Who is there to certify to the correctness or incorrectness of the assertion? The Canal Company will pay no attention to it unless it changes its tactics, and a correction by any individual would not have much weight. As a fact to know something of how laborers die in the tropics, we may read Stanley's Adventures in Africa by J. T. Headley, in which it says: Of the three hundred that had set out, nearly three years before, to cross the continent, only one hundred and twelve were left to return by sea to Zanzebar, how many of the missing ones deserted the expedition or fell into the hands of the natives as prisoners is not stated, but, there is little doubt that a greater portion of the loss was in this way, also many fell into the continuous fight down the Upper Congo, some were drowned, and now and then a man died; sunk down as Stanley says and died; it is the old story, a few hours delirious, and then the immediate burial. During nearly six years, the author of this, has passed through all these scenes, and every fresh instance was only a reminder of the old story of death in the tropics, the character of such a life is to either depress the individual or to make him inflexibly determined as in the case of Stanley. It has never been my intention to add to the confusion of ideas, which now exist in regard to the canal and for this reason, during my nearly three years stay on the work, have written only the short article which appeared in the ENGINEERING NEWS during the summer of 1884. By request began articles to the *American Engineer* and to the Rensselaer Society—both are unfinished and have long since been laid aside. The question is, what is to be done? There are persons now connected with the canal, and engaged on the active work of construction, they know the details in and out, some are Americans, and all of those now in mind, are graduates of our first engineering school, though some of them are natives of South America or the West Indies, yet they are in heart sympathizers with us due to their education; and if they should so desire could give a statement of value to American Engineers and the general public. They would naturally be very guarded in expression, but if the movement was preconcerted there is little doubt of a good result in getting truths if nothing more.

As an illustration of the things that are written, the reader is referred to an article in the present March number of Frank Leslie's Popular Monthly, headed "Progress at Panama," and illustrated with maps and a portrait of M. DeLesseps. The author has a great many truths in his favor which he has got from published accounts, but which were already history and not new; yet when he steps into unknown ground he commits fatal errors. His map of the canal line is a negative copy, and his description of the line is entirely mixed up and unbecoming his title of C. E. A plea of entire ignorance of what he was writing about, could be taken up, but, where is the reader left? It is fortunate the article did not appear in an engineering journal, and perhaps it may be added, to the credit of our engineering editors, that such a paper if presented to them would have been sent to the waste basket.

J. H. CURTIS, C. E.

BIBLIOGRAPHY.

Aux Etats Unis,—notes de voyage d'un ingenieur, Paris Ghio.

This work, the production of a Belgian engineer, M. Paul Trasenster, has been already referred to in the ENGINEERING NEWS. The writer has confined himself to giving a plain description of the great material facts of American life, which are so striking in the eyes of the stranger, and which seem so common-place to us. It is therefore of a rather statistical character, and shows here and there of what a comparitively "sleepy" character corresponding European institutions are. Some persons might imagine for instance that the electric light was utilized to an almost equal extent on the continent, but such is far from being the case. Monsieur Trasenster was impressed on his return, via Liverpool, by the comparative gloom of that gloomy city. In fact, it must seem a little strange to the average foreigner "that wires are allowed in the streets and houses, the contact of which would be mortal, and pipes, from which any leak would suffocate a family." Speaking of American railroad building, the author gives an instructive comparison when he states that in 1882 the American railway companies built 18,600 kilometres of new lines, or more than what the French Government, on the proposition of M. de Freycinet, could accomplish in twelve years. Chicago seems to have especially excited the wonder of our travelling engineer, and no engineering work seemed to him so stupendous as the *menu* of the Palmer House. Speaking of his visit to Marquette and his being interviewed by a reporter, the writer says: "The American engineer receives his old country colleague very kindly. He freely interchanges ideas with him, and will answer even the most indiscreet questions without requiring any reciprocity. It is very seldom indeed that he makes any inquiries with regard to processes or apparatus in use in Europe. Evidently he considers that American industry is superior to its old world rival and has nothing to learn." In Pennsylvania the hospitality of Mr. Eckley B. Coxe, ex-president of the American Society of Engineers, was enjoyed. In conclusion, the author thinks the States offer a very large field of observation and instruction to the visiting engineer.

THE GROWTH OF CITIES.—Mr. Arthur T. Hadley, Commissioner of the Connecticut Labor Bureau, in a recent lecture to the Yale graduate students on "The Growth of Industrial Freedom," said: "The removal of the restrictions upon the movement of population has greatly affected the growth of cities. In the United States in ninety years the population has increased about thirteen times, but the city population has increased ninety times. It now forms nearly one-quarter of the whole population, instead of only one-thirtieth, as was the case in 1790. This growth of city population form sone of the most serious problems of modern times. In years of business prosperity the population moves from the country to the cities; in years of depression it is thrown out of work, it demands employment as a right, when such employment is impossible in overgrown cities it is impossibe to prevent the growth of large cities, but something may be done to check it. Railroad discriminations have given cities unnatural advantages to such an extent as to be injurious to the railroads themselves. Anything that checks this discrimination will be of service in lessening this evil."

The Trans-Caspian Railroad.

The Trans-Caspian Railroad commences at Fort Michailowsk, situated on the eastern shore of the Caspian Sea at about 40 degrees latitude, and runs in a south-east direction into the interior of Asia. Its construction was commenced in August 1880; at the end of 1882, the division from Michailowsk to Kisil-Arwat, 143.5 miles long, was completed. The continuation from Kisil-Arwat to the Persian boundary at Askabad, 130.5 miles long, is still in course of construction. The railroad has a single track with the Russian gauge of 4.93 feet; it is managed by the Ministry of War; the local general manager is an officer of the general staff. The maximum grade is 95 feet per mile, the sharpest curve 405 feet, the width of the road-bed 15.4 feet. The cuts are mostly in sandy material. Fences, either made of closely set boards or of brush, are erected along the road, where drift sand may become obstructive. The wooden ties are saturated with naphta. This natural product plays an important part in the Trans-Caspian railroad, which passes through a timberless country. Naphta is used as fuel for locomotives and all other steam engines; also for lighting and heating houses, and as fuel for making bricks and lime, etc. The lack of drinkable water, which could also be used for the engines, is a great disadvantage of this road. While building the first section, the sea water was made drinkable by chemical process.—(*Archive fuer Eisenbahnwesen*, Heft III. 1885.)

Some English Notes.

A steam digger costing $5,000 is at work in Essex. It turns over ten acres of deep spading a day, and enormous crops have been grown on the land thus treated.

England's position at the head of the metallurgical industry of the world is undisputed. Yet England buys metal railway sleepers and stop-planks from Belgium, and sabers and bayonets from Germany.

The size of London sewers may be judged from the fact that a horse fell into one the other day. To get him out he was led to a distant opening, this opening being 110 feet below the street level.

Gordon's issue of paper money was expected to be a great drain on the British treasury, but the Arabs, full of hatred for England, destroyed it wherever found, so there will be no Gordon money deficit in the Treasury Supply bill this year.

Explosion in a Catch-Basin at the Capitol.

BY HORACE ANDREWS, C. E., ALBANY, N. Y.

The accompanying diagram is designed to illustrate the conditions which exist in a catch-basin just outside the walls of the capitol at Albany, and which were the cause of a violent explosion, on the morning of March 11th, whereby the large flag-stone cover was broken into fragments.

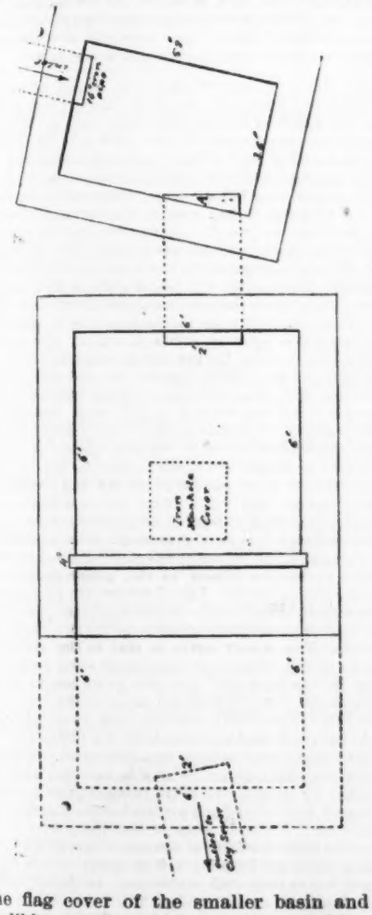
A portion of the sewage discharged from the capitol passes out of a 16-inch iron pipe into a smaller basin, shown to the right on the diagram, with a vertical fall of 5 feet. Thence it flows through a 2-foot pipe into a large basin, 6 feet by 12 feet and 12 feet deep, trapped across the center by a vertical flag-stone descending to within about a foot of the bottom. Through neglect, about 5 feet of nearly solid sludge had accumulated on both sides of the vertical flag, so that the sewage could barely force its way under its lower edge.

It would appear from the condition of the walls of the right hand side of the large basin, that the thick sludge at the bottom has often sealed the passage under the flag to such an extent as to cause the sewage to rise, until sufficient head was obtained for it to force its way through. On the morning of the 11th inst., an obstruction occurred that caused the sewage to rise at least 2 feet, completely

sealing the pipe into the smaller basin and causing a small deposit of sewage sludge (containing a squeezed lemon) on the top of the pipe at *A*.

As sewage continued to flow into the large basin, and as there was no outlet for the confined air, the pressure of the latter soon sufficed to break the 6 feet by 8 feet flag cover into fragments, and to throw the 2-foot square iron manhole cover a distance of 10 or 12 feet. The large flag cover probably weighed 2,700 pounds, and it was very carefully fitted and cemented into place. A pressure of nearly 1,300 pounds would be brought upon the large flag-stone, covering the basin, for *each inch* that the water rose, as soon as the 2-foot pipe into the smaller basin was sealed and no outlet was found for the inflowing water. Such a pressure would soon be great enough to raise the large flag-stone, but the adhesion of the cement and the weight of the earth upon its edges probably prevented this. The iron manhole cover must have been quite firm in its seat or it would have been thrown off before the pressure became great enough to break the flag-stone.

The release of the compressed air in the large basin was followed undoubtedly by a sudden inflow to the small basin, through the pipe connecting them. This secondary explosion, which would have been imperceptibly near the first, was of sufficient force to move



the flag cover of the smaller basin and to audibly expel air from traps within the capitol, though the iron inlet-pipe is well ventilated by numerous rain-water leaders of large size.

The accident described, which was fortunately attended with no worse result than the loss of the flagcover, is an interesting proof of the necessity of providing proper ventilation in sewage works. Confined air acting against large surfaces may easily exert an enormous pressure when from any cause -- becomes even slightly compressed. The principles involved are the same as in the hydrostatic press, but the elasticity of air renders its pressure of a dangerous character, since it may burst forth with explosive violence when the pressure becomes excessive.

It is not necessary to refer to the unsuitable character of the trap here used, since it had recently been condemned by the State Board of Health and will doubtless be replaced by some more sanitary device.

THE HISTORY AND STATISTICS OF AMERICAN WATER WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

801—FORT SMITH, ARK.

Fort Smith, Sebastian county, Arkansas, in lat. 35° 10′ N., long 94° 42′ W., is at the head of steamboat navigation on the Arkansas river, on undulating ground. The town was founded in 1838 on the land adjoining a U. S. military post and reservation. Water works were built by a private company in 1884 after plans of C. W. Hill, taking the supply from the Poteau river, a mountain stream. The water is taken from the river through a filter of sand and gravel, built 20 feet square around the inlet pipe leading to a pump well, whence it is lifted 125 feet by steam pumps built by Smith, Vaile & Co., to a reservoir built in excavation and embankment and lined with stone laid in cement, and holding four million gallons at 110 feet above the city level. The pumps are arranged to furnish direct pressure of 125 pounds on the mains, in case of fire.

Distribution is by 12 miles of cast-iron pipes of 12 to 4 inches diameter, with 62 fire hydrants, 15 gates, 325 taps and 3 meters. Service pipes are of galvanized iron. The daily consumption is 150,000 gallons. The population in 1880 was 3,099 and is stated to be 10,000 now. The works have cost $130,000. The capital stock of the company is $100,000 and the bonded debt $125,000. The annual expenses are $2,600 and the revenue from water takers $9,000, besides the hydrand rental from the city, which is $3,600. D. S. Thomas is President of he company and Superintendent.

WATER

FULLERTON, Neb., is figuring on building water-works.

AT Hastings, Neb., a public vote will be taken on April 15th, on the question of issuing water-works bonds.

BATAVIA, N. Y., which is now lighted by gas, is talking of introducing the electric light.

ASHLAND, NEB., desires to increase its water-works bonds from $7,000 to $12,000.

STRASBURG, Pa., is considering the question of electric lighting for its streets.

ATTENTION of Cast-Iron Pipe Founders is called to the advertisement of the Kearney Canal and Water Supply Co.

THE City Water Company of Belleville, Ill., has filed a certificate of increase of capital stock from $175,000 to $250,000.

A BILL has been introduced in the New Jersey Legislature to empower the city of Passaic to sell bonds for a sewerage system to the amount of $120,000.

PROFESSORS BAWDITCH AND BOLTON, sanitary engineers, of Boston, have investigated the water supply and sewerage of Atlanta, Ga., and will make a report.

THE Brooklyn Electric Construction Company has commenced work on the electric light plant for the city of Mobile.

WARE, Mass., has obtained a charter from the Legislature for a water supply to be taken from Muddy brook and Leonard's brook.

SENATOR Worth has presented by request a bill repealing the law which authorizes a water company to supply water to the dry-goods district of New York for extinguishing fires.

THE Van Depoele electric street light system at Ann Arbor, Mich., has been extended. Five more lights were ordered. A contract was made for a year at $120 per light.

THE Shenango Natural Gas Company has taken an engine and boilers to its territory in Hancock county, W. Va., and will begin drilling several wells immediately.

THE Long Branch Sewer Company has been organized by the election of Dr. S. H. Hunt, President, and the ground is broken, with the prospect that the work will be finished by May 25th.

THE suit of the city of Poughkeepsie, N. Y., against ex-Chief Engineer Brown, of the gas works, has resulted in a verdict of $17,875 in favor of the plaintiff, that being the amount of the claim.

THE six per cent. $80,000 bonds of Beatrice, Neb., to build water-works, were negotiated by the council, March 9th., to Harris & Co., of Chicago, for $81,878, or 102.35 per cent.

IT is proposed to enlarge the Central drainage district, Mason county, Ill.: this being rendered necessary by the adoption of the Crane Creek route by the Commissioners instead of the Quiver route.

A DITCH COMPANY has been organized to dig a ditch across Chaffee county, Col., from the Arkansas river to the South Arkansas river. Capitol, $400,000. Incorporators, W. B. Page, W. F. Patrick, R. I. Page and A. B. Blow. Headquarters at Leadville.

THE plans of H. H. Harrison, of Stillwater, for the proposed Rochester, Minn., water-works, provide a reservoir, covering 30 acres, on Bear creek, which will furnish power to run a pump and electric lighting apparatus. Estimated cost of the whole work, about $50,000.

THE Summerville, S. C., Town Council has let a contract for the completion of the canal to drain Saw-mill branch. It will be about two miles long, and two-thirds have already been completed by Messrs. Taylor & Stanland, and the South Carolina R. R. Co.

THE Natural Gas Company of West Virginia, has let the contract for thirty miles of 10 and 12-inch pipe to the National Tube Works, of McKeesport, and the Pennsylvania Tube Company, of Pittsburg, each company to furnish fifteen miles. The exact route will be decided upon at once, and work will commence at Wheeling about the middle of April.

MACON, Ga., is looking for means of increasing its water supply, the reservoir on Windsor Hill being scarcely large enough. During the week ending March 6th, the gas company laid 5,280 feet of 4-inch mains, and 5,000 feet of 3-inch piping. They have laid pipes to the railroad shops for heating the tires in the manufacture of car wheels.

THE Detroit Mich., Water Board has adopted new regulations. The board has decided to purchase the extra 30-inch pipe for new lines, to be laid next month, from the Detroit Pipe and Foundry Company, which, in December last, contracted to furnish 3,000 tons of pipe of all sizes at $24.65 per ton.

THE Improved Coal Gas Company has been incorporated, with a capital stock of $500,000, "to manufacture and deal in gas or any aeriform, gaseous, or elastic, or other fluid or matter of any description, for lighting, heating, cooking, locomotion, propulsion, or any other purposes to which such can be applied." Its trustees are John W. Newbery, Albert H. Kolfoed, Edward L. Snow, De Witt C. Bates, and Joseph Ernenwein.

The asbestine system of irrigating is attracting some attention, as by it the chilling of the surface of the soil by flooding and subsequent baking by the hot sun are avoided. The plan, which has been a complete success wherever tried, consists of allowing water to pass through pipes laid a short distance below the surface in trenches several feet apart, with small holes at intervals on the upper side to permit of the escape of the water, which percolates through the soil, moistening it perfectly. The results are said to be most flattering, especially when pipes are laid under trees.—Denver, (Col.) *Tribune Republican.*

BOSTON, March 9th.—Parties interested in the Bay State Gas Company have bought the controlling interest in the Consumers Gas Company, thus practically uniting what has heretofore been the opposition in the water gas war in Boston and its vicinity in a common cause. Parties equally interested in the Bay State Company have also secured all rights in the United Gas and Improvement Company, of Philadelphia, carrying with them the advantages of the co-operation of the Standard Oil Company, of Pennsylvania. There are indications that the South Boston Gas Company will be brought into harmony with the water gas movement, so far as Boston is concerned, and negotiations are pending with several of the smaller gas companies

No. 10. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

Town and State.	Topography.	Difference of level in town.	In Business District.		Fire Pressure.
			Day Pressure.	Night Pressure.	
		feet.	lbs.	lbs.	lbs.
Austin, Nev.	hilly.	50 to 800	45 to 150	45 to 150	45 to 150
Bristol, Conn.	hilly.	165	110 to 120	110 to 120	110 to 120
Bristol, R. I.	level.	0	60	60	80
Catskill, N. Y.	hilly.	100 to 200	95	90	90 to 180
Columbia, Cal.	level.	30 to 50	30	30	30
Decatur, Ill.	undulating.	25	45	35	80
Denver, Col.	level.	50	40	40	80 to 100
East Portland, Or.	level.	30	80	80	100 to 150
Fresno, Cal.	level.	16	15 to 40	15	80
Grass Valley, Cal.	hilly.	80	80 to 100	100	90 to 120
Harrisburg, Pa.	level.	——	60	——	——
Independence, Kan.	undulating.	10	35 to 38	35 to 38	35 to 150
Jackson, Tenn.	undulating.	0	40	40	80
Keene, N. H.	level.	15 to 20	45	55	45 to 55
La Crosse, Wis.	level.	25	60	40	100
Madison, Wis.	hilly.	20 to 80	55 to 60	40 to 50	110 to 140
Nashua, N. H.	hilly.	50 to 80	50	50	80 to 100
Ogdensburg, N. Y.	level.	very little.	35	40	80 to 100
Park City, Utah.	hilly.	50 to 80	86	——	——
Red Bank, N. J.	level.	0	55	55	80
St. Albans, Vt.	hilly.	100	110	128	110 to 150
Tapleyville, Mass.	——	——	70	——	——
Union City, Ind.	hilly.	20 to 30	30	30	80 to 100
Wallingford, Conn.	rolling.	75	95 to 130	95 to 135	100 to 135
Yarmouth, N. S.	hilly.	100	37	60	——

in the neighborhood. The Bay State Gas Company has been incorporated by Sidney Ward, James G. Janeway, Allan McCulloh and David Paton. Capital, $5,000,000.

THE Mount Vernon, N. Y., Board of Trustees has granted a franchise to the New York and Mount Vernon Water Company to lay mains through the streets of the village, to supply water for fire and domestic purposes. They also agreed to take 100 hydrants for fire purposes at a yearly rental of $40 each.

THE New York Supply Company, 50 and 52 John street, New York, has been formed to succeed W. C. Duyckinck, and sell railway, machinists', engineers', steamship, miners' and general supplies. M. H. Daniels, President; Levi Best, Vice-President; Robert G. Weeks, Treasurer and General Manager; C. Homer Bush, Secretary; J. H. Forey, Sales Manager.

THE St. Louis branch of the Henry R. Worthington Hydraulic Works has sold a 750,000 gallon compound steam pump, together with boiler feed pump and fittings, for a zinc mine near Webb City, Mo. Included in the recent deliveries was a large elevator pump, with 16-inch steam cylinders and 12-inch water plungers.

THE contract for the complete system of water-works for the city of Beatrice, Neb., was awarded to the Holly Manufacturing Company, of Lockport, N. Y., at their proposition of $71,100. The system comprises about eight miles of pipe, from 16 to 4 inches diameter. Seventy-seven hydrants and two Gaskill pumping engines of 1,500,000 capacity each. Works to be completed and ready for use by September 1, 1886. Cast-iron pipe will be used. Kalamein pipe was offered but not considered.

PITTSBURG, PA., March 10.—Pneumonia has become epidemic at McKeesport. Within the last few days more than a dozen residents of the borough have fallen victims to its ravages, and physicians attribute it to natural gas. One of them said: "I have no doubt that natural gas is responsible, not only for pneumonia, but also for many other diseases of the respiratory organs. It is a great convenience, but as it is burned now the grates are almost closed up and no provision is made for ventilation. The result is the atmosphere of the entire house not only becomes very dry, but is vitiated by the products of the combustion." Considerable sickness in this city has been traced to the same source, and quite a number of people are talking of discontinuing the use of gas as fuel.

PITTSBURG'S old water-works are all wreck and ruin. They stand at the corner of Pike and Twelfth streets in a fearfully dilapidated condition. The tall smoke-stacks have all fallen down, and great pieces of sheet iron flap in the wind at the ruined base of the chimneys. Not since the famous water famine of four years ago has a wheel inside the building turned a single revolution or the dust been disturbed. The interior and exterior show that the ravages of time have played havoc with the once "majestic" and "powerful" works on which Pittsburg not a long time ago depended wholly for its water supply. The walls are crumbling and threaten to fall at any moment. The roof is rotten, and has been patched so often that only an expert can distinguish the lines of demarcation between a "patch" and the original roofing. The chimneys may have been battered and riddled by volleys of shot and shell. Their shape and condition do not dispute the supposition.

COL. WILLIAM LUDLOW, the retiring chief engineer of the Water Department of Philadelphia, is credited with a saving of $750,000 during the three years of his administration. Besides the new Spring Garden station, two new 15,000,000-gallon engines have been placed there. One 10,000,000-gallon engine was put in the Frankford pumping station and one 7,500,000-gallon engine at Roxborough. The financial results are regarded with satisfaction. The following table shows the quantity and cost of pumpage:

Year.	Total Pumpage.	Pr. ct. of increase.	Cost,	Pr. ct. of decrease.
1882	24,691,440,430	0·00	$252,370	0·00
1883	25,284,957,251	2·44	246,914	2·16
1884	25,495,179,353	3·23	215,896	14·45
1885	25,165,020,072	1·92	185,141	26·64

Although more water was pumped in 1885 than in 1883, the work was done at a much less cost. Yet the percentage of increase of pumpage is lower for 1885 than for 1883.

THE Holly Manufacturing Company, of Lockport, N. Y., has recently issued a new descriptive and illustrated pamphlet of steam and water power pumping machinery, which is the most complete and interesting publication of the kind, ever issued by this company.

The pamphlet contains tables of friction of water in pipes; of horse-power required to pump water against heads from 10 to 400 feet; of discharge of water through apertures under different heads; and a "duty diagram," showing at a glance, the amount of coal required for different duties under various heads. The company has also published, in pamphlet form, a series of reports on expert duty tests of the Gaskill compound engines, by Professor Charles T. Porter, John W. Hill, H. P. M. Birkenbine, and Professor T. C. Mendenhall, all which must be of interest to engineers and water-works superintendents. The company will send from its office at Lockport, N. Y., or 44 Broadway New York City, a copy of either or both pamphlets to any interested applicant.

A PROPOSED INVERTED SIPHON TUNNEL AT MARSEILLES, ILL.—Mr. Ebin J. Ward, Mem. Western Soc. C. E., has in the February number of the *Journal of the Assoc. of Eng. Societies*, an ingenious plan for improving the water power of the Illinois river at Marseilles, Ill. A water power company formed in 1865, owns three-fourths of about 10,000 H. P. as derived from a newly constructed dam, and the individual owning the remaining fourth wishes now to utilize it, but he must take it from the south side of the stream where the bank is high and precipitous without favorable mill sites. On this south side, about three-quarters of a mile down stream is good ground, but the cost of cutting a race to it would be very expensive, estimates of various plans ranging from $16,000 to $17,000. Mr. Ward now suggests an inverted siphon tunnel through a bed of tough fire-clay lying 54 feet below the bed of the stream. He proposes to sink an inlet shaft above the dam to the clay and then to tunnel about 3,000 feet to meet an exit shaft near the down-stream mill-sites; afterwards providing the proper races, etc. The tunnel would be 12 by 12 feet, need no timbering as no squeeze is obtainable as proven in the neighboring coal mines, and no lining would be used as this fire-clay would require blasting, and will not wear under much greater velocities of water than any it would be subjected to. The economy comes in, in selling the fire-clay as excavated, a market being already assured that will make each lineal yard of tunnel pay for itself as it is dug. He estimates that to make the tunnel, two shafts, and a working shaft, open race-way and necessary gates and valves would not exceed in cost $5,500.

BROOKLYN'S PUBLIC WORKS.—The report of the City Engineer of Brooklyn, N. Y., Mr. Robert Van Buren, for the year 1885 has recently been issued. With regard to the water supply it is stated that the capacity of the existing conduit has been underestimated, and some apprehension felt of the necessity of a relief conduit, which would involve an additional expense of about $1,500,000; it has now been determined that the conduit has a capacity of 75,000,000 gallons which is amply sufficient, at least for the present. The average daily consumption for the year 1885 was 43,414,270 gallons, an increase of 4,535,236 gallons over that for 1884. This yearly increase is extraordinary and cannot be accounted for by the increase in population alone, but means a greater waste of water. The average daily consumption for the summer months of 1885 was 44,928,224 gallons, while that for 1884 was only 37,846,859 gallons. This is an increase of about 7,000,000 gallons per day for these months in one year. Referring to this waste Mr. Van Buren says, "It is difficult to check reckless waste of water without metering private houses. If people are made to pay for wasted water they will be more careful in its use and reduce their consumption, and yet I do not like to urge the meter system until the getting of an additional supply is made more difficult than it is at present. The winter waste is very great, but we are in a better condition to supply water during the winter, as the ponds generally fill before winter sets in. Last February the average daily consumption was nearly 49,000,000 gallons, and it ran up as high as 56,000,000 gallons on the 11th day of that month. The winter waste is due to the allowing of water to run freely to prevent house pipes from freezing. It has been said that this waste can be stopped by making people cut off the water at the cellar wall: but it is not possible to enforce such a regulation, and I do not think that the occupants of a house should be put to such inconvenience and discomfort. In passing upon plumbing plans for new houses the water pipe should be placed out of the reach of frost if possible. I cannot recommend any system for checking the waste at present; I simply suggest that the purveyor be allowed a sufficient force of competent inspection to keep up a thorough inspection from house to house. We have found that such inspection results in reducing the consumption materially. The house owner is reminded of the fines imposed for willful waste, and running water closets, leaking pipes, etc., are detected." The extension east of the water-works system is strongly urged, and as it will take three years to finish the extension, prompt action should be taken on the plans already prepared. The average supply from the Forest Stream and Clear Stream stations for the eight months from April was 10,400,000 gallons per day, and but for these stations the city would have been in serious trouble with its water supply last summer. It is stated that tests made by the Board of Health show the water to be clear and wholesome.

THE Knickerbocker avenue sewer extension is well advanced, and will be completed by May next. The

epth of this sewer below the street surface varies from 19 to 32 feet, and the route is through streets that are solidly built upon. It is 12 feet in diameter, and is designed to drain about 2,800 acres. In advertising for proposals for the work, the specifications left it optional with the bidders to bid for a tunnel or for an open cut no bids were received for tunneling and the contracts were given to the lowest bidders for the open cut. Mr Charles Hart getting Section 1, and Mr. Edward Freel Section 2. After the work was started, the property owners on South Fifth street, between Second street and Eleventh street, protested against an open cut and demanded that this part of the sewer be completed in tunnel. The change added greatly to the cost, but their appeal was granted and Mr. Hart was ordered to construct that part of his work in tunnel. Mr. Hart made an arrangement with Messrs. Anderson & Barr, and the work has been pushed forward as rapidly as this kind of work can be. The tunnel so far as worked runs through fine sand, and considerable water has been found. It is a difficult piece of work, and much credit is given to the engineer-in-charge and the contractors for their success. Mr. Freel has his work in good shape. His excavation is being done with the Carson machine. By using this machinery the sides of the streets are unobstructed. No dirt is thrown upon the sides of the streets, as the excavation is carried to the back fill by means of buckets running upon iron ropes suspended on frame work directly over the trench. Mr. Van Buren speaks very favorably of this system.

The appropriation for street repairs has not allowed of much being done beyond keeping the streets in a safe condition, and there are many miles of cobble paving which should be replaced with more suitable stone. Several streets have been repaved with granite blocks.

NEWS OF THE WEEK.

CONTRACTING.

Fuel, Forage and Straw.—Proposals will be received at the office of the Depot Quartermaster, Jefferson Barracks, Mo., until April 10th.

Street Cleaning.—Proposals for cleaning the streets of this city south of Fourteenth streets for three years will be received at the office of the Commissioner of Street Cleaning, 31, 32 Park Row, until April 15th.

Miscellaneous Quartermaster's Stores.—Bids will be received until March 24th, at the Depot Quartermaster's office, corner of Houston and Greene streets. Schedules can be seen at the office.

Dredging.—Proposals will be received by the Bureau of Yards and Docks, Navy Department, until March 26th, for dredging about 60,000 cubic yards of mud, sand, clay, etc., in the Wallabout channel, and Cob-Dock basin opposite the New York Navy Yard.

Lighthouse.—Proposals will be received by Major W. H. Heuer, Engineer Eighth Lighthouse District, New Orleans, La., until April 3rd for a tower and keeper's residence at Ship Island, Miss.

City Hall.—The Vincennes, Ind., City Council invite architects to submit plans for a new city building. Cost limited to $850,000. Plans will be received till April 1st, and information may be obtained of C. M. Allen, Jr., City Clerk.

Brick Paving.—Proposals will be received until April 1st by Geo. E. Sybrant, City Clerk, Jacksonville, Ill., for a brick street pavement.

Plumbing and Sanitary Fixtures.—J. S. Farrell & Co., of Indianapolis, Ind., has been awarded the plumbing works and sanitary fixtures for the new Delaware county, Ind., court house.

State, War and Navy Department Building.—The lowest bid for the iron work of the dome was from the Builders Iron Foundry, Providence, R. I., for $10,500. The next lowest was from an Indianapolis firm, $15,000.

Bulkheads.—Proposals will be received at the Department of Public Works, Municipal Building, Brooklyn, until March 23d, for constructing new bulkheads adjoining the abutments of the Metropolitan avenue bridge.

Gas Works.—Proposals will be received at the Custom House, Richmond, Va., until March 30th, for the purchase of a gas generating machine (Tiffany Improved Oil Gas Works), with capacity for 200 burners.

Furniture.—Proposals will be received at the Brooklyn Department of Public Works until March 24th, for furnishing the Police Court House on Adams street near Myrtle avenue.

Court House.—Proposals will be received at the office of the County Clerk, Lincoln, Neb., until April 20th, for the construction of a court house at York, York county, Neb. Cost, not to exceed $50,000.

Paving.—In Chattanooga, Tenn., there is some controversy over the paving of streets, the question lies between granite blocks, limestone blocks and asphalt. The prices are approximated at $4, $1.25, and $3.25 per square yard respectively.

Public Contract Notice Bill.—ALBANY, N. Y., March 16.—The Assembly has passed Mr. Curtis' bill requiring public notice to be given in cases of contracts on behalf of the State for an expenditure of more than $500, and for letting such contracts to the lowest bidder.

Y. M. C. A. Building.—The contract for the erection of the Y. M. C. A. building, at Philadelphia, has been awarded to Mr. W. A. Chesterman for the sum of $25,920, Messrs. Cope & Stewardson, of Philadelphia, being the architects, and Mr. A. L. West, the resident architect.

New Bridges.—SALINAS, CAL., March 8th.—The Board of Supervisors to-day decided to receive bids for the construction of two bridges across the Salinas river, one on the road about three miles from Salinas, the other at Soledad Crossing. They propose to issue bonds for $100,000.

Miscellaneous Supplies.—Proposals will be received at the Department of Public Charities and Correction, 66 Third avenue, until 9:30 A. M., March 26th, for furnishing groceries, dry goods, tin, lime and cement. See *City Record*.

Green Pond, Walterboro' and Branchville Railroad.—The contract for the entire work from Green Pond to Walterboro', S. C., has been awarded to Messrs. Cahill & Rousk for $25,800, the work to be completed and the road in running order within six months. The work will begin at once and be pushed forward rapidly.

Paving Material.—The material with which Memphis, Tenn., is paved is brought an average distance by rail and river of about 200 miles. Stone on the Louisville & Nashville R. R., within 200 miles, is 6 cents per 100 pounds, 240 to 260 miles, 7 cents, and 160 miles, 5 cents. On the Memphis & Charleston R. R., for 145 miles, 5 cents, and 240 miles, 7 cents per 100 pounds. Tishamingo gravel from the Memphis & Charleston R. R., 120 miles from Memphis, cost $1.60 per cubic yard of 3,000 pounds. Gravel from Tennessee ridge (160 miles) on the Louisville & Nashville R. R., cost $1.75 per 3,000 pounds. Mississippi river gravel and sand at Memphis cost from $1 to $1.25 per cubic yard delivered on the work.

Pipe Laying.—Proposals will be received until April 1st, by the Superintendent of Water-Works, Minneapolis, Minn., for laying water pipes in that city, as follows:

	ESTIMATED LENGTH.
6-inch pipe	46,211
8-inch "	36,156
10-inch "	5,435
12-inch "	16,350
16 inch "	9,172
24-inch "	6,254

Specifications may be seen at the office of the Engineer of the Board in the City Hall.

Business Block.—The contracts for rebuilding the Brush estate business block, Detroit, Mich., have been awarded by architect W. E. Brown. The block will be of brick with cut-stone facings, four stories high, exclusive of basement, with a frontage of eighty-three feet on Randolph street and 100 feet on Croghan street. So much has been said concerning the outlay involved in rebuilding the property that the architect declines to make public the amount. Topping & Fisher are the contractors for the mason work; Bachelder & Long, cut stone; J. B. Wilson & Co., beams and iron work; Hutton Bros. & Co., galvanized iron and tin work; Geo. Hanley & Bro., plastering; Lloyd, Flewelling & Co., carpenter work; Dean, Godfrey & Co., painting and glazing; J. W. Gilbert, roofing; Samuel Dickson, plumbing. Work has been commenced on the excavations.

Sewers.—The following proposals have been opened and announced for constructing sewers in Brooklyn:

John Morrissey—30-inch brick sewer, $5.10 per foot; 18-inch pipe sewer, $2 per foot; 15-inch pipe sewer, $1.35 per foot; 12-inch pipe sewer, $1.10 per foot; manholes, complete, $35 each; street basins and pan, $120 each.

Thomas Monahan—30-inch brick sewer, $3.45 per foot; 18-inch pipe sewer, $1.21 per foot; 15-inch pipe sewer, $1.15 per foot; 12-inch pipe sewer, 91 cents per foot; manholes, complete; $36 each; street basins and pan, $98 each.

John Bray—30-inch brick sewer, $3 per foot; 18-inch pipe sewer, $1.36 per foot; 15-inch pipe sewer, $1.25 per foot; 12-inch pipe sewer, $1 per foot; manholes complete, $30 each; street basins and pan, $90 each.

John Bogert—30-inch brick sewer, $3 per foot; 18-inch pipe sewer, $1.35 per foot; 15-inch pipe sewer, $1.20 per foot; 12-inch pipe sewer, 95 cents per foot; manholes complete, $32 each; street basins and pan, $95 each.

Edward Gorman—30-inch brick sewer, $2.90 per foot; 18-inch pipe sewer, $1.30 per foot; 15-inch pipe sewer, $1.10 per foot; 12-inch pipe sewer, 83 cents per foot; manholes complete, $33; street basin and pan, $90 each. An informal bid was received from Charles Hart.

Street Improvement Bonds.—Bids will be received by the City Auditor, Cleveland, O., until April 3rd for the purchase of $175,000 4-per cent. bonds of that city.

Bridge Suit.—The Wrought-Iron Bridge Company of Canton, O., has brought suit against the village of Attica, N. Y., to recover the price of the new bridge which was erected over the Tonawonda on Main street, last year, and for which payment was refused on the ground of the price being extortionate.

Pine Wood.—The following proposals for furnishing 100 loads of Virginia pine wood for the Brooklyn Fire Department have been received: For western district, John J. Clancy, $3.95 per load; R. B. Leech, $3.98; Frederick Tielke, $4.00. For eastern district, John J. Clancy, $3.70; Frederick Tielke, $4.00; T. J. Patterson, $4.25.

Water Pipe, Etc.—Proposals will be received at the Office of the Engineer Commissioner, Washington, D. C., until March 23rd, for 15,000 feet 6 inch cast-iron water pipe, 30 6-inch 4-way water gates and boxes, and 10 6-inch 2-way water gates and boxes, for the water supply of Washington, D. C.

Supplies.—Proposals for furnishing supplies for the Hospital for the Insane, the Institutes for the Blind and Deaf and Dumb, and for the Reform School for the quarter ending June 30th, will be received until March 31st by the Commissioner of Public Lands and Buildings, Lincoln, Neb.

College.—The contract for building the south L of the Presbyterian College, at Longmont, Col., was let recently to contractor M. W. Boyd of that place for $9,000. The building is to be of brick with cut-stone trimmings. The difference in favor of brick against stone entirely was about $1,000. The contract calls for the completion of the building by September 1. Bids were received from Boulder, Lyons and Longmont parties.

School.—The School Commissioners of Albany, N. Y., have awarded contracts for the completion of School No. 7, as follows;

Antillo Pasquini, mason work	$6,377.00
David M. Alexander, carpenter work	5,889.00
John Harrigan, painting and glazing	997.00
E. Fitzgerald, plumbing	838.55
Mead & Lawlor, stone-cutting	351.00
James Ackroyd, roofing	198.00

The committee on construction and repairs has been directed to contract for the furnishing of the building.

Paving, Pipes, Etc.—Proposals will be received by the City Engineer of Richmond, Va., until April 1st, for furnishing and laying brick paving; repairing and relaying brick and stone paving, curbing and flagging; laying trap, corner and apron stones, etc.; ironwork for street basins; cement; and feed for city mules and horses; also for vitrified clay pipes, as follows:—

2,500 to 4,000 lineal feet 12-inch pipes.
150 to 300 " 10-inch "
200 to 400 " 8-inch "
1,000 to 2,500 " 6-inch "
75 to 150 branches, different sizes.

New Jail.—Sealed proposals will be received at the office of Commissioners, Savannah, Ga., until 12 o'clock M. April 26, 1886, for the material and workmanship required in the erection of a jail and jailer's residence for Chatham county, in the city of Savannah. Proposals will be received in lump for the whole work, and also separate bids for stone work, brick and terra-cotta work, tin and galvanized iron work, carpenters work, plastering, painting, plumbing and gas fitting, iron and steel work, bunks, wire work, mantels and grates, speaking tubes and bells.

Plans can be seen in the office of the Commissioners and at the office of Messrs. McDonald Brothers, architects, Louisville, Ky., and printed specifications will be furnished on application at either office. Bond $5,000. Jno. R. Dillon, clerk, C. C. C. Savannah, Ga.

Water-Works Bids, Kankakee, Ill.—George Cadogan & Morgan, Chicago, twenty-five years franchise, not less than 7 4-5 miles of mains, not less than seventy hydrants at $57 per hydrant per year, additional hydrants at $50 per hydrant, $3,990.

Dennison & Correll, Muscatine, twenty years franchise, eight or ten miles of mains, direct pressure system, 120 hydrants at $42 per hydrant, and additional hydrants at the rate of $40 per hydrant, $5,040.

Dennison & Correll, Supplementary Bid, for gravity and direct pressure combined with reservoir, 100 hydrants at $62 each, and additional hydrants at $50 each, $5,200.

S. D. Phillips & Co., Lafayette, source of supply at Waldron, direct pressure, ten miles of mains, 100 hydrants at $50 each, and additional hydrants at same rate, $5,000.

Hinds, Moffett & Co., Watertown, N. Y., twenty years franchise, direct pressure and gravity with reservoir, 100 hydrants at $55 and thirty additional hydrants free, $5,500.

Hinds, Moffett & Co., Supplementary Bid, not less than 9 1-2 miles, without reservoir, 100 hydrants, twenty additional free, $5,000.

Union Depot.—Work has begun on the union passenger depot at Birmingham, Ala. Chas. Pierce, of Indianapolis, Ind., is the contractor.

The Chicago, Milwaukee & St. Paul R. R. Co. has let the contract for its extension to Kansas City, to Herman Clark & Co. Work is to be completed by August 1, 1887.

A Fine Union Depot.—Work will soon be commenced on the new union depot at Indianapolis. The building will cost about $1,000,000 and will be one of the finest railway structures in the United States.

Fire-Proof Vaults.—The Coles county, Ill., Board of Supervisors has decided to construct fire-proof vaults in the court house, and to put iron cells in the jail, at a cost of about $10,000.

Building Prospects.—The architects and builders of Philadelphia and other eastern cities are busier than they were a year or two ago, on drawings and estimates for an unusually large number of houses, churches, halls, manufacturing establishments and public buildings, large and small. The investments in building operations are being conducted on a large scale, and a real estate exchange is about being established in Philadelphia to facilitate operations of that character.

Big Contracts.—Mr. D. W. Townsend, of Marshalltown, Iowa, is an extensive contractor and builder, who makes public work a specialty. He now has under construction the Marshalltown court house, to cost $115,000; J. C. Corcoran, of Chicago, architect. He also has, in connection with Messrs. Wakeman Bros., the contract for a court house at Council Bluffs, Iowa, for $142,000, for which the work of excavation has just been begun; Echo & Mann, architects. Mr. Townsend has just closed a $200,000 contract for a hotel building at Sioux City, E. W. Loft, of Sioux City, being the architect.

Bricks, Iron, Etc.—Contracts for furnishing the Philadelphia Commissioners of Public Works with certain materials have been awarded to the lowest bidders, as follows:

For bricks required during the year, Amos Dotterer, at $7.20 per 1,000; for wrought-iron clamps, L. Sykes & Son, at 4 8-10 cents per pound; for rolled iron girders and beams for floors of clock tower, Phœnix Iron Company, of Trenton, at $3,887.50; for materials for roof of boiler room, Manly & Cooper Manufacturing Company, at $9,313; for granite curbing for pavilions, Mt. Waldo Granite Company, at $1,747. The contract for furnishing cement for the year was awarded to J. Rex Allen, the only bidder, at $2.92 per barrel of Portland cement (400 pounds) and $1.13 per barrel of Rosendale cement (300 pounds).

Coney Island Sewerage.—A comprehensive sewerage scheme has been devised by W. H. Powers. Drain pipes laid from Sheepshead Bay to the extreme west end of the island, excluding for practical purposes the Brighton, Manhattan and a couple of minor properties, will convey the refuse to a huge tank to be located on Coney Island Point. This tank will be remote from the more populous section of the island and will be carefully covered to prevent the escape of noxious gases. The difficulties incidental to the engineering portion of the scheme have not been lost sight of, but the main trouble will arise from the fact that the Concourse, which skirts the greater portion of the property affected, is so low as to interfere with the proper incline of the drain pipes. If it were possible to raise this thoroughfare about 5 feet, the difficulty complained of would be obviated. Fifteen bids were received as follows:

P. W. Van Houten	$112,250
John Curran	231,795
Feon & Quien	118,370
D. De Kremen	198,900
J. Cox & Co.	13 ,724
D. H. Valentine	127,424
B. J. Coyle	124,324
J. McArdle	152,635
D. Furey	122,096
Ferris & Halliday	146,419
J. McHarner	132,420
J. A. Wyman	195,316
G. W. Phelan & Co	166,708
E. Freel	125,811
A. A. Quinn	137,075

The contract was awarded to Mr. Van Houten. The specifications call for 300 manholes, 200 feet of 12-inch iron pipe, 1,000 feet of 18-inch, and 6,500 feet of 20-inch. The quantity and dimensions of the cement pipe to be laid is as follows: 30-inch, 1,500 feet; 24-inch, 8,000 feet; 18-inch, 600; 15-inch, 2,400 feet; 12-inch, 1,400 feet; 9-inch, 4,000 feet, or a total of 151,770 feet, equal to about twenty-eight and one-half miles of piping.

The South Street Bridge Repairs.—Jones & Benner, who, as creditors of Child & Conklin, the contractors for the repair of the South Street Bridge, Philadelphia, recently made an unsuccessful attempt to have their claims satisfied out of the money unpaid by the city, before that of the contractor who completed the work after Child & Conklin's default, have begun a new equity suit for the purpose of securing what is left of the appropriation. The contract was originally made for $81,920. Jones & Benner supplied the contractors with material, and still have a claim for $12,595. The city has a balance of $10,147 to Child & Conklin's credit. In June, 1884, the latter gave Jones & Benner a power of attorney to collect all city warrants coming to them under the contract. This power of attorney, it is alleged, they now threaten to revoke. Jones & Benner, therefore, ask the court to decree that they are entitled to the unpaid balance, and enjoin the Chief Commissioner of Highways and City Controller from allowing it to go to any one else.

Railroads, Bridges and Canals.

The **Mississippi & Louisiana Bridge & Railroad Co.**, of Natchez, Miss., is to be incorporated.

The Union Pacific R. R., has a surveying party in the field locating a line of railroad to connect the Oregon Short line with Seattle, W. T.

The Talladega & Coosa Valley Railroad is pushing the extension to Broken Arrow, Ala., to connect with the East and West Railroad.

The Ohio River R. R. extension from Parkersburg, W. Va., to Point Pleasant is to be commenced in April at Letart.

A Maine Central R. R. Branch.—A line is proposed from Pittsfield, on the M. C. R. R., to Monson Junction on the Bangor & Piscataquis R. R.

International R. R.—The survey of an east and west route across the State of Maine is being pushed forward.

The Jackson Southern Railway Company, has been incorporated to build from Jackson, Minn. to a point on the southern state line.

The Burlington and Missouri Railroad is surveying the new line from the Cheyenne end of the road to Atwood, Col.

Central Missouri Railroad.—The bill to construct a railroad bridge across the Mississippi river, at or near Alton, Ill., has passed the Senate.

The Baltimore & Eastern Shore R. R. Co., has been incorporated by E. E. Jackson ,Thomas B. Taylor, John Robinson, T. Tunis and Joseph B. Seth, to build a road from Eastern Bay to Salisbury, Md. Capital $500,000.

U. P. R. R. Bridge.—The second pier of the Union Pacific bridge at Omaha has been sunk to rock 65 feet below low water. Two men died March 11th, of "caisson fever;" several cases have occurred.

Chateaugay Railroad.—Engineers are now running a survey for the extension, from Lyon mountain to Loon lake, N. Y., to accomodate pleasure travel to that famous resort.

Colorado Central Railroad.—This old line between Fort Collins and Cheyenne is to be reopened, as the towns along the line are larger and more important than those on the Gre ly line from Cheyenne to Denver.

Arkansas River & Western Railroad.—The line is being graded between Hutchinson, Kan., and St. John, and it is expected the cars will be running into the latter place by July 1st,

The James River Valley Railroad from Jamestown, Dak., on the Northern Pacific R. R., to La Moure, a distance of forty miles, has been leased to the N. P. R. R. for a term of ninety-nine years.

The Montana & Idaho R. R. has been incorporated to run from Missoula through the Bitter Root valley to Salmon City, Idaho, and thence over the divide to Big Hole river. It will also tap the Utah and Northern R. R., at some point.

The Denver & Rio Grande R. R. has a large force of men now working on the road toward Delta from the Utah line. The force is replacing the wooden bridges with more substantial ones, putting in stone piers, drain tiles, etc. The work is now completed nearly to Delta.

Motor Line.—The Minnesota & Northwestern Railroad's "motor line" from the union depot St. Paul, to West St. Paul will be opened shortly as far as the city limits. A trial trip was made on March 8th. The line is to be worked by dummies of the double-ender description.

Change of Southern Gauge.—During the latter part of May and the beginning of June, several miles of railroad in the south will be changed from the 5-feet to the standard (4 ft. 9 in.) gauge. Arrangements have been made so that the changes to track, engines and rolling-stock may not interfere with the working of the roads. This change will be made on nearly every railroad at present having the wide gauge south of the Ohio and Potomac rivers.

Central American Rapid Transit.—On a railroad thirty-six miles long in Guatemala trains have lately been started twice a week, under a new management, in which the engine is preceded by a hand car and competent officials, to protect passengers in the rear from accident.

Chicago, Burlington & Quincy Railroad.—A survey has been made which contemplates straightening the road at several points, which would shorten the line several miles between Chicago and Burlington. In some places the new track would run some distance from the present main line.

Minneapolis, Sault Ste. Marie & Atlantic Railroad. W. D. Washburn, of Minneapolis, Minn., is said to have arranged with the Bank of Montreal to furnish $5,000,000 for the speedy construction of this road, 400 miles in length, to give the Canadian Pacific R. R. entrance to Minneapolis.

N. Y. & Brooklyn Bridge.—Consulting Engineer Paine, advises the trustees that it would be desirable to have a duplicate system of engines and machinery, and also an extra cable laid alongside the present one, which could be used in case of an accident. Plans have been prepared for two condensing engines of 600 horse-power each. The cost of the extra machinery was averaged at $40,000.

Pittsburg, Cleveland & Toledo Railroad.—A corps of engineers is now running lines for the extension from Akron to Chicago Junction. Two lines have been surveyed under the direction of Chief Engineer Agnew, one running through Medina, and another, a more southerly route, by way of Lodi. The object in view is to secure the most direct route between Akron and Chicago Junction, a distance of seventy miles, with the best possible grade.

The Grand Trunk Railroad is making arrangements to begin at an early date the construction of a line from Peterborough to Ottawa, Ontario, on the survey of the old Toronto and Ottawa R. R. Such a line, running in connection with the Canada and Atlantic R. R., would be shorter than the Canadian Pacific line between Toronto and Montreal, even with the air line from Smith's Falls finished.

The Canadian Pacific Railroad in Montana.—A short time ago the citizens of Helena invited Chief Engineer Barclay, of the Canadian Pacific, to visit them, and it is now proposed to connect the Canadian Pacific with the Central R. R. and this will tap the very center of profitable railroading in Montana. The Montana Central Railroad, now constructing local lines to open up the mines, has been opposed by the Northern Pacific, but local feeling is very much in favor of this road, as well as of the C. P. R. R. connection.

Windsor Locks Bridge.—The newly finished Windsor Locks, Conn., bridge has been attached on the suit of B. M. Douglass. He had agreed to sell his pier, ferry franchise, etc., to the company for $20,000 in stock of the company, it being understood, he says, that only $40,000 should be issued. The capital was afterwards increased $10,000, and the Douglass party which by a small purchase had held the majority of the stock, found itself in the minority and was ousted.

Pacific Railroad Lands.—The House has passed the bill requiring Pacific railroads to pay the cost of surveying their lands and to take out patents thereto, with an amendment providing that nothing in the act shall be construed or taken in any wise to affect or impair the right of Congress at any time hereafter further to alter, amend or repeal the various Pacific railroad acts, or to impair or waive any right or remedy now existing in favor of the United States.

The Willmar & Sioux Falls Railroad has been incorporated to run from Willmar, Minn., to Granite Falls, Marshall and Pipestone. Capital stock $2,000,000. The board of directors are John M. Spicer, George H. Perkins, of Willmar; Gorham Powers, Granite Falls; John B. Tyler, John G. Schultz, Marshall; Charles C. Goodenow, Daniel E. Sweet, Pipestone; Edwin A. Sherman, Henry T. Carson, Sioux Falls. The new road is generally supposed to be an extension of the Manitoba's St. Cloud & Willmar branch, now building.

Railroad Grant Lands.—The bill reported by Senator Van Wyck to provide for the taxation of railroad grant lands provides that no such lands shall be exempt from local taxation by States, Territories, and other municipal corporations on account of the lien of the United States thereon for the cost of surveying, etc., or because no patent has been issued therefor. It authorizes the Attorney-General, at the expiration of 30 days after demand has been made upon any railroad company to pay the costs of surveying, selecting or conveying any lands granted to it, to begin proceedings to collect the same in cases where payment has been refused. It provides that all such lands sold for taxes shall be taken by the purchaser subject to the lien to be paid as the Secretary of the Interior may provide.

The Little Rock & St. Louis Railroad, has been incorporated for the purpose of building from Little Rock, Ark., to some point east on the Texas and St. Louis Railroad.

The Silver Lake Railroad, about six miles long, running from Silver Springs, on the Erie & Buffalo and Rochester & Pittsburg railroads, has been sold to John J. Carter, President of the Bradford, Bordell and Kinzua, R. R., for $125,000.

Exhibition of Metallic Ties.—The Belgian Society of Engineers and Industrials has opened an exhibition of metallic sleepers of various kinds at Brussels. The Society is also collecting documents, reports, etc., bearing on this subject.

The Pittsburg, Knoxville & Allentown R. R. Company, which proposes to build a line from Pittsburg to Knoxville Borough, has been chartered at Harrisburg. Capital stock $100,000. Directors William J. Hunter, of Knoxville; William Adams and F. Grimes, of Pittsburg.

The Rockaway Village Railroad Company has been incorporated with a capital stock of $25,000. The road is to be constructed in the town of Hempstead, Queens county. Christopher Cunningham, of Brooklyn, is one of the incorporators.

An Amended Charter for the Canadian Pacific R. R.—OTTAWA, ONT., March 4.—A strong effort is being made this session to have that portion of the Canadian Pacific Railway charter which refers to the construction of branch lines south to the international boundary line repealed.

A Railroad Depot Burned.—WINNIPEG, MAN., March 2.—The handsome new depot of the Canadian Pacific Railway was completely destroyed by fire yesterday. The structure cost $250,000 and the contents were valued at $20,000. Several of the surrounding buildings were badly scorched. The origin of the fire is unknown.

The Manchester and Iowa Railroad Company has been incorporated, having for its object the construction of a line from Manchester to connect with the Chicago, Milwaukee and St. Paul R. R., at or near Delhi. The capital stock is $200,000, and the proposed line will be about six miles in length.

New York and Hudson Valley Aqueduct Company.—A bill has been introduced by Mr. Traphagen incorporating Homer A. Nelson, W. W. Laman, Clarence Seward, Gilbert Robertson, Jr., and twenty others as the New York and Hudson Valley Aqueduct Company to draw from the Adirondacks a water supply for Hudson Valley cities, capital, $60,000,000.

The Denver & New Orleans R. R. will be sold today for debt amounting to $3,117,112. The property to be sold includes the railroad and telegraph line of the Denver & New Orleans Railroad Company, extending from Denver to Pueblo, the branch from Manitou Junction to Colorado Springs, and also the branch from Franceville Junction to Franceville, all in Colorado.

Mississippi River Improvements.—The House Committee on Levees and Improvements of the Mississippi river has agreed to report favorably a bill to appropriate $3,000,000 to close gaps in and strengthen the levees of the Mississippi river, the money to be expended by the Mississippi River Commission under the control of the Secretary of War.

Cable Railroad Litigation. SAN FRANCISCO, March 3.—The Market-street Cable Railway Company has instituted suits in the United States Circuit Court against the Sutter-street Cable Road Company, which will determine the real ownership of the present improved system of cable railways." The suits are for a perpetual injunction and damages.

Cincinnati, Jackson & Mackinac R. R.—The Jackson & Ohio R. R. and the Cincinnati, Van Wert & Michigan & R. R. have been consolidated under the above title. The affairs of the new company are in a prosperous condition, and means are in sight of a speedy completion of the line. It is hoped to have the road completed from Jackson to a point within thirty-seven miles of Cincinnati this year.

Chicago & Northwestern R. R.—Surveyors are running two lines from near Lander, Wyo., one to Salt Lake City, the other southwest into Idaho to head off the Oregon Short Line. The surveyors say that both lines though preliminary are for undoubted purposes of location, and that both will be in active operation in two years time.

The Kansas Midland R. R. has been incorporated, as a Burlington & Missouri project. The proposed line is to run from Wichita up the north side of the Arkansas river to Hutchinson, thence north to Red Cloud, Neb., on the Burlington & Missouri R. R. Total distance about 200 miles. Directors for the first year, C. R. Miller, President; S. W. Campbell, Vice-President; J. D. Davidson, Treasurer; O. H. Bentley, Secretary; W. E. Stanley, R. E. Lawrence and H. G. Lee. The headquarters are at Wichita.

Denver, Memphis & Atlantic R. R.—Arrangements are being made between the Directors and S. H. Mallory, of Charlton, Iowa, of the firm of Fitzgerald & Mallory, railroad contractors, for the construction of the road. It is said that 100 miles from Winfield, Kan., west will be completed and in operation by July 1st. Another entire line from Baxter Springs to Larned, a distance of 325 miles, is to be completed by January 1st, 1887.

Brooklyn Central Elevated R. R.—The Fulton street elevated line has been incorporated under the title of the Central Elevated Railroad. Capital, $1,000,000. The nine directors named in the articles of incorporation are Austin Corbin, J. Rogers Maxwell, Henry W. Maxwell, William Richardson, Newbury H. Frost, John G. Jenkins, Wendell Goodwin, Edward A. Abbott and James H. Frothingham. The routes laid down are those agreed upon by the Trunk Line Commissioners.

Columbus & Eastern R. R.—The Muskingum, O., County Court has authorized this company, which is now in the hands of a receiver, to build a branch from Redfield to Zanesville and from Zanesville to the Brush Creek district to connect with the proposed Black Diamond R. R. Receiver's certificates are to be issued in payment for construction and a syndicate of Columbus capitalists is said to have been formed to furnish the money. It is very exceptional for a judge to grant a receiver authority to build or extend a road.

The Storm King Bridge.—A contract to build the bridge, which is to be of the cantilever type, has been signed with the Phœnix Bridge Company. The contract also calls for the building of twenty miles of connecting track, and the amount involved is $6,600,000. There will be two piers, 150 feet high, one on each side of the main channel of the Hudson. These piers will sustain a treble cantilever, of which the roadway wil be about 225 feet above the water.

Jersey City Railroad Connections.—Extensive changes will be made by the Pennsylvania R. R., in Jersey City. Two other roads are interested—the Erie and the West Shore. It is proposed to establish a union depot about midway between the Pennsylvania cut and Erie tunnel. A double-track road is to be built from the Pennsylvania cut across and connecting with the Erie tracks to Wiehawken, with the West Shore tracks. Business will be facilitated, as cars can be easily transferred from one road to another without delay. The tracks will be built at once, provided the Jersey City authorities throw no obstacles in the way.

Chicago, Rock Island & Pacific R. R. Extensions.—The company proposes, if St. Joseph, Mo., will subscribe $250,000 of stock, to build two extensions west from that city, one to run in a northwesterly direction through the northern tier of counties in Kansas into Nebraska, and the other to run in a southeasterly direction through Kansas down into the Indian Territory. The last-named route will cover the survey formerly made for the proposed St. Joseph & Rio Grande Railroad. Each of the extensions is to be 800 miles in length. The extensions will be known as the Chicago, Kansas & Nebraska Railroad. The construction of these lines would necessitate the building of another bridge over the Missouri river at St. Joseph.

Railroad Tie Plantations.—Hon. R. W. Phipps, Forestry Commissioner of Ontario, in a letter from Southern Kansas to The Toronto *Globe* writes: "One railroad board here, knowing that the growing of wood, when set about in earnest, is neither a slow nor difficult task, has established in Kansas the largest artificial plantation of forest trees in North America. These railway gentlemen themselves gave out the contract for planting over a square mile of land with young saplings of the catalpa and ailanthus; and their president, observing the success of their experiment, and impressed with its probable excellent financial results, has had planted at his own expense, as a speculation, as much more. These are situated near the little town of Farlington, Kan.

Smith's Falls & Montreal Short Line.—The route has been definitely located, and the engineers think they have secured the best in the interests of the Canadian Pacific R. R. The line will cross one of the branches of the Ottawa within a stone's throw of the Grand Trunk bridge at St. Anne's, and the contract for the work will be let in a few days. Sixteen thousand tons of English steel rails have been purchased for the line to Smith's Falls. They will be 72 pounds to the yard and will enable the C. P. R. R. to attain a higher rate of speed with greater safety than is possible on lighter rails. When the company's line from Montreal to Toronto, via Smith's Falls, is completed this year, the trip between the two cities will be reduced to about eight hours as against thirteen at present. The entire through line will be completed, and trains will be running by next November. The lines will be let in sections, and the company will push the work.—Smith's Falls *Independent*.

The Southern Kansas Railroad has commenced work on its extension from New Kiowa to Camp Supply, I. T. It will build one hundred miles of road this summer towards Mobeetie, Texas.

A Massachusetts Narrow Gauge Railroad is to be built this summer from Harwich on the Cape Cod division of the O. C. R. R. to the shore at Chatham. Length about eight miles. Mr. Stillman Rodman, of Providence, R. I. is the chief projector.

Hudson River Improvements.—The engineers are getting everything in readiness to resume operations in the spring. The unfinished work on contracts will be hurried along. It will require about two months to complete the New Baltimore dyke, and about the same time to finish up the work at the state dam, Troy. When the ice goes out of the river the corps will immediately take soundings to ascertain whether any serious bars have formed. It is thought that the ice-pack at Pleasure island will throw up a formidable bar.

Southern Projects.—Bills have been introduced in the Kentucky legislature incorporating the Grayson Springs Railroad Co., capital stock $10,000; the Bowling Green & Northern Railroad Co.; the Ohio, Kentucky & Virginia Railroad; and the Frankfort Street Railroad.

Bills have been introduced in the Virginia legislature to incorporate the Powell's Fort Mining Co., the Appomattox Red House & Hot Creek Railroad Co., and the Newport News Dry Dock & Construction Co.

Aqueduct Commissioners.—Senator Reilly has presented a bill increasing the number of new Aqueduct Commissioners of New York by three. One of these new commissioners is to be a Republican, another a Democrat and the third a civil engineer, politics not specified. The civil engineer is to be paid at the rate of $5,000 yearly. The new men are to be appointed by the Governor, with the consent of the Senate.

A Jersey City Ship Canal.—One of the important bills pending before the New Jersey Legislature is that for the construction of a ship canal along the line of Mill Creek, in Jersey City. Such a canal will, it is claimed, afford harbor room for vessels of heavy draft, and will, if constructed, be the site of a vast system of commercial storehouses. It is estimated that if the Legislature fails to authorize Jersey City to make the canal, the Pennsylvania R. R. Co., will build it at its own expense.

Chicago, Milwaukee & St. Paul R. R. Extensions.—Work on the extension to Kansas City is to be begun very soon, and will be pushed rapidly as the line must be finished by August, 1887. The company will also build in Dakota from Andover, on the Hastings and Dakota division, to a point fifty-five miles north; from Scotland to Mitchell, a distance of forty-seven miles; from Ipswich, the present western terminus of the Hastings and Dakota division, to a point thirty miles nearer the Missouri river. The extension to Bismarck will probably not be taken in hand during the present year.

Missouri Pacific R. R.—Mr. Hoxie, Vice-President, recently made a proposition that if Henrietta, Texas, and the towns interested, would raise a bonus of $70,000 and right of way and depot grounds, he would extend the road from Gainesville to Henrietta, and give that town the same service as any town on the main line. He further stated that if an answer was received promptly, he would begin the construction of this line by May 1st. The town resolved that a favorable answer be returned.

Illinois Central R. R.—The thirty-sixth annual meeting of the stockholders was held at Chicago, March 10th, the president, James C. Clarke, presiding. The unusually large number of 1501 stockholders, owning 202,978 shares, was represented in person or by proxy. The annual report of the directors was read and approved. The action of the directors in issuing $1,500,000 of 4 % gold bonds, and $2,500,000 of 3 1-2 % gold bonds, and in causing them to be secured under the mortgage of August 10, 1874, was approved by the unanimous vote of the stockholders present. John Elliott of Messrs. Riggs & Co., Oliver Harriman, of Messrs. Low, Harriman & Co., and Levi P. Morton, of Messrs Morton, Bliss & Co., were elected directors of the company. The Board now consists of his Excellency Richard J. Ogiesby, Governor of Illinois, ex-officio, Stuyvesant Fish, Edward H. Harriman and William Waldorf Astor to serve until 1887; Sidney Webster, Robert Goelet and S. Van Rensselaer Cruger, to serve until 1888; James C. Clarke, B. F. Ayer and Walther Luttgen to serve until 1889, and John Elliott, Levi P. Morton and Oliver Harriman to serve until 1890. Apart from the Dutch syndicate, which for many years has represented a large but unknown number of small holders, the shares are owned by 2,795 individuals, firms and corporations, 2,106 of whom hold less than 100 shares apiece. The average holding is less than eighty-six shares. The number of American stockholders is 1,195 against 1,066 last year and 801 in 1884, and they now hold over thirty-five per cent. of the entire capital. In the State of Illinois, sixty-one stockholders own 6,707 shares.

Market Report of Engineering Materials.

New York March 18, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.00c	@ 2.10c
" steel	2.35	@ 2.45
Tees	2.35	@ 2.40
Beams and channels, American	3.0	@
Tank Plates	2.15	@ 2.20
Shell Plates	2.4	@ 2.5
Steel plates, Tank	2.5	@
WROUGHT-IRON PIPE., PITTSBURGH.		
Butt welded, black ..... Discount	42½	@ 45
" " galvanized ..... "	32½	@ 35
Lap welded black ..... "	60	@ 62½
" galvanized ..... "	42½	@ 45
Boiler tubes ..... "	55	
RAILS.		
Steel (large lots at mill)	$34.00	@ $35.00
Old rails	21.00	@ 21.50
Old rails, steel	22.00	@ 23.00
R R. spikes	2.40c.	
R R. splice-plates	2.00	
R R. track bolts, square nuts	3.00	
Barb-wire fencing, galvanized		5.00
" " painted		4.00
Corrugated iron		
Nails		
Iron, per keg		2.45
Steel do.		2.60

METALS.

COPPER.		
Lake Superior	$11.45	@ 11.50
Other Brands		10.12
LEAD.		
Com. Domestic	4.90	
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.15	@ 5.25

BRICK.

Cargoes (afloat)		
Haverstraw ..... per M.	8.00	@ 8 50
Fishkill		
Up-River		
Jerseys	7.00	@ 7.75
Long Island	8.00	@ 8.50
Pale	4.75	@ 5.00
FRONTS.		
Croton, red	11.00	@ 14.00
" dark	11.00	@ 14.00
" brown	10.00	@ 13.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85.00	@ 120.00
Fire brick	24.50	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs	2.65	@ 2.90
K. B. & S. " "	2.75	@ 2.95
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50	@ 5.00
" Fine	8.00	@ 10.00
" Portland	2.45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BABSON:		
K. B. & S.	2.35	@ 2.60
STANDARD CEMENT Co.		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00	@ 1.10
Standard		1.15
Coll 's Portland	2.15	@ 2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand,		

ASPHALT.

ROCK.		
Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	1.00	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
" Choice "	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30,00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "	5.75	@ 6.00
" sawed 18 in. "		
LATH, Cargo rate "	2.30	

PAINT.

Lead, white, American dry per lb	.04¾	@ .06
" " " in oil pure "	.06½	
" English, B. B. in oil "	.08¾	@ .08¾
" Red, American "	.05¼	@ .05½
Litharge "	.05	@ 05½
Venetian red, American "	.01	@ .01¾
Indian red "	.05	@ .10
Vermillion, American lead "	.10½	@ .12½
Paris green "	.15	@ .20
Umber, Amer. raw and powdered per lb.	.01¾	@ .01¾
Drop black, Amer. "	.07	@ .13
" Eng. "	.11	@ .13
Chrome green	.05	@ 20
Oxide zinc, American "	.03¾	@ .04
" French "	.06	@ .08

Trade Notes.

THE Anniston (Ala.) Car Works, previously reported as having been purchased by W. R. Tuttle, of Knoxville, Tenn., will be leased or operated by the Alabama Car Co.

THE Central Iron and Steel Company, Brazil, Ind., has voluntarily advanced the wages to their puddlers and rollers 50 cents per ton.

THE Baltimore & Ohio R. R., is surveying a new line from Washington to Connellsville. The proposed route will make the western coke haul seventy-five miles shorter.

TWO 3½-inch Ingersoll "Eclipse" rock drills complete, with electric blasting outfit, have been bought for work on the St. Louis, Kansas City & Colorado R. R.

THE Hoyt Railroad Track Crossing Company of Chicago, has been incorporated at Springfield, Ill. Capital $100,000. Incorporators, Frederick J. Hoyt, Alonzo J. Snow and Frank L. Taylor.

MANUFACTURERS of heavy structural iron in Ohio and Pennsylvania, especially those manufacturing railroad bridges, are over-crowded with work.

THE Columbus, O., Rolling Mill Company has been reorganized and the capital stock increased to $300,000. It is proposed to manufacture structural iron and steel.

ORDERS for 11,000 tons of steel billets were placed in England recently by Pittsburg manufacturers, at $31.50 per ton. American-made billets cannot be sold for less than $34.

A British company has obtained a concession from the King of Siam to work over 2,000 square miles of teak forest in the valley of Moung Gaan, the rivers from which flow into the Menam, on which is situated the capital city, Bangkok.

THE Minnesota & Northwestern Railroad will erect a round-house and repair shops just outside the city limits of St. Paul Minn., upon twenty-five acres of land given them for that purpose. No plans for the shops have yet been made, but some of the heavy machinery has been ordered. From 100 to 200 men will be employed.

THE Cuyahoga Rolling Mill Co., of Cleveland and Cuyahoga Falls, O., made an assignment March 6th, to F. R. Harris, of Youngstown. The company is composed of James Ring, Thomas S. Gordon and Andrew McEwen. Assets, $6,000; liabilities not stated. The assignee's bond was placed at $7,000.

THE Antrim, Mich., Iron Company has been incorporated. The purpose of the organization is to carry on the business of smelting, manufacturing and selling pig-iron from iron ores. Capital stock, $100,000.

THE St. Louis Mexican Investment and Improvement Company, of East St. Louis, capital $2,000,000, has filed articles of incorporation. Its object is investment in and improvement of mining property. The incorporators are Charles W. Holtcamp, Joseph H. Williamson and George F. Keller.

THE Eastern Forge Co., of Portland, Me., is making forgings for twelve locomotives, part for the Old Colony R. R., and part for the Boston and Maine R. R. The company has just finished the forgings for the new steamer now being built at Bath for the Maine Central R. R., and is figuring on forgings for twenty-five engines for the New York Elevated R. R.

THE Colorado Coal and Iron Company's report shows that the company has earned $110,000 over last year, and has a balance of about that amount in cash after paying all fixed charges. The company has bought and paid for 1,000 acres of coal land. The Denver & Western balance of $87,000 it is expected will be paid shortly. The friends of the company talk about a dividend this year.

THE firm of Chatfield & Grant, builders, in New Haven, Conn., has been dissolved, Mr. Philo Chatfield retiring. He is seventy years old and has been in the firm thirty-four years. The concern has built many of the large buildings in New Haven, including the city hall, county jail, medical college, Yale art building, Trinity church, secret society buildings, Second regiment armory and Winchester armory.

IT is announced that the Pratt Coal and Iron Company (Alabama) has completed arrangements for the erection at once of two blast furnaces, and that they will be located on Village creek, two miles from the mines and four from Birmingham. The company will also build 300 more coke ovens.

THE American Iron and Steel Association reports that there were produced of cut nails and spikes in this country, 6,698,615 kegs of 100 pounds each in 1885, against 7,581,379 in 1884 and 7,762,737 in 1883. The decreased production in 1885 is very largely due to the stoppage of many Western nail factories for the last seven months of the year, in consequence of the disagreement over nailers' wages.

THE Kensington Engine Works, Limited, of Philadelphia, Pa., are just completing the erection of three engines, with all the necessary fixtures, piping, feed-water heaters, etc., for the Electric Light and Power Co., Chester, Pa. The station, which was designed by Mr. G. P. Denis and the Kensington Engine Works is said to be one of the most complete that has been put up. The engines are the Buckeye Quick Speed, with two band-wheels, driving direct to the dynamos.

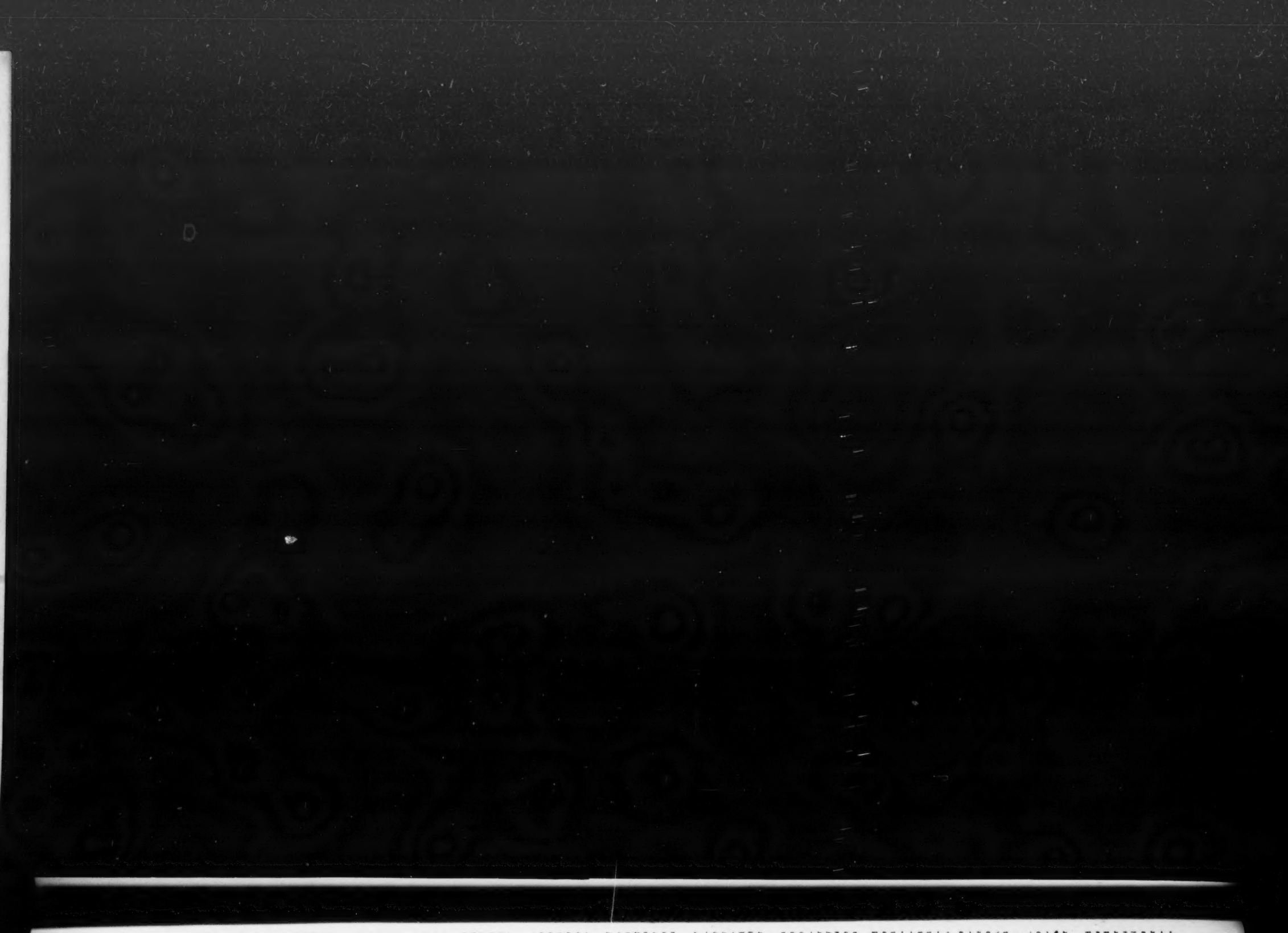
ABOUT 1,700,000 tons of Bessemer ores have been sold, half of that in Pittsburg alone, since the first of the year, to be delivered from May 1, 1886, to May 1, 1887. A fortnight ago from 12,000 to 13,000 tons of Bessemer pig metal were sold in Pittsburg at prices ranging from $19 to $20, according to quality. This is more metal than has been sold since the first of the year. The sale of raw material is looking up. Scrap iron and old rails are coming down with prospect of still lower reduction as soon as railroad construction commences.

INVESTMENTS in houses are the best, paying 10 to 20 per cent.' and hence capital is rapidly seeking investment in that direction. One Philadelphia banker has arrangements made for the construction of 500 houses, and if successful will prepare the way for 500 more. A Philadelphia editor is engaged in the construction of a thousand houses, and smaller builders have plans laid for the erection of hundreds ranging in cost from $3,000 to $8,000 each. In New York, contracts have been placed within a week for the erection of eight, nine or ten story apartment houses.

THE steel-mills are all very busy, nearly every department in all of them being on double turn, with an outlook never known to have been any better. There is a move on foot to increase the capacity of the steel-rail output at the Edgar Thomson steel-mill. The full capacity now is 650 tons of rails a day, but for over 200 days of last year the average daily run reached nearly 700 tons. This is to be increased to 900 tons a day. These rails are all rolled on one train of nine rolls in three sets, making the train three rolls high. It is the most complete train of rolls in the world.

THE New York and Boston syndicate which recently secured control of the Coal creek mines, in Tennessee, is said to have options in nearly every coal field in the locality. They propose at an early day to extend the Oakdale branch from Knoxville junction, on the Cincinnati Southern R. R. to Clinton, there to connect with the Knoxville and Ohio R. R., but the independent coal companies are endeavoring to resist this undertaking, as it will only place them at the mercy of the East Tennessee, Virginia and Georgia, R. R., which controls the Knoxville and Ohio.

THE Old Colony R. R., is having six new engines built. The cylinders are 18 in. by 26 in., and the driving wheels 5 feet diameter. The Taunton Locomotive Works and the Mason Machine Works are building them. Twenty-seven passenger cars are also being built, the number being distributed among several firms. They are 60 feet long, with 42-inch Page wheels, and will seat seventy-two passengers.

"HAVE what the public want. Sell it with moderate profit. Advertise largely in First-Class Newspapers, and you are bound to do a trade. Let the newspaper be the best you can obtain, no matter what the cost. It is but natural that an advertiser must, in a degree, share in, and thereby gain from, the respect which a reader entertains for an ably-conducted journal."

THE Bucyrus Foundry and Manufacturing Company are so rushed with orders that they hardly know which way to turn. They are increasing their facilities as fast as possible, and have ordered quite a large amount of new tools, which will nearly double their present capacity. They have a number of orders for steam shovels and dredges, and within a short time have shipped a steam shovel to San Francisco, and will have another to go to the same place shortly. They are also enjoying a good trade in mine cars, mine car wheels and axles, and other mine supplies. They number themselves among the optimists now, and have great faith in the revival of business, and the "good time coming."